EFFECT OF FEEDING STREPTOCOCCUS FAECIUM TO ARTIFICIALLY REARED PIGS[1]

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Summary

Two trials were conducted with a total of 112 artificially reared pigs to evaluate the effect feeding Streptococcus faecium. The areas studied were growth and feed efficiency, mortality rate, daily scour score, blood parameters (total leukocyte numbers and differentials), and in vivo determination of cell-mediated immunity. The results of the trial indicate that there was no significant advantage to feeding Streptococcus faecium to artificially reared pigs.

Introduction

Streptococcus faecium (SF) is a lactic acid producing bacteria that is common in some probiotic products. The proposed mode of action of this organism is the synthesis of lactate as it colonizes in the gastrointestinal tract, causing a decrease in pH. It has been theorized that the lower pH may suppress the microbial population, especially Escherichia coli. With the decreased number of E. coli, there could be a reduced likelihood of toxin production. There are also reports that suggest that SF stimulates the early development of the bodies' immune system. Although these claims have been postulated, very little research has been conducted to evaluate the effectiveness of feeding SF to young pigs.

Experimental Procedure

All pigs in these trials received an injection of gentamycin (5 mg) and iron dextran within 12 hours after birth. Pigs were allowed to suckle for 24-48 hours postpartum. At this time, they were removed from the sow and placed in individual cages (1 ft x 2 ft x 1 ft) in an environmentally controlled room with an average temperature of 90°F. Pigs were allotted to treatment groups by litter and weight. Treatments began 6 hours after the pigs were placed in the cages. Pigs were fed a non-medicated milk replacer (1 part milk to 3 parts water) for 14 days and changed to a semi-solid high fat diet for the remainder of the 21-day trial. The SF culture[3] was mixed into the first portion of milk fed each morning. Pigs were fed individually to full appetite. Before each feeding scour scores (1 = none; 2 = semi-solid; 3 = watery) were determined twice a day. On days 6 and 20, pigs

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[1]This study was funded by Medipharm, Division of Triple "F" Feeds, Des Moines, IA

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[3]Culture of Streptococcus faecium M 74 was provided by Medipharm, Division of Triple "F" Feeds, Inc., Des Moines. The culture was isolated initially from the intestines of breast-fed infants.

were weighed, a 10 ml-blood sample from the external jugular vein was collected for cell counts and differentials. A 1 ml-injection of the nitrogen phytohemagglutinin (PHA), was given in the flank on day 7 and 21 of the study. Flank-folds were measured and the amount of swelling that developed was used as an indicator of cell-mediated immunity.

The treatments in Trial 1 were: (A) control (none), (B) continuous feeding of billion colony forming units (CFU) of SF per day, (C) single dose of a billion CFU of SF per day, and (D) 3 doses of a billion CFU of SF per day for three successive days.

In Trial 2, the treatments were: (A) control (none), (B) 3 doses of billion CFU per day for three successive days, (C) 3 doses of 3 billion CFU per day for three successive days, and (D) continuous feeding million CFU per day.

Results and Discussion

Trial 1 The effect of feeding SF on mortality, performance and cell mediated immunity of artifically reared pigs is shown in table 1. Seven of 56 pigs died during this trial. Six of them were receiving SF and 4 had received SF for 1 day. The pigs that received SF for 1 day gained significantly ($P < .05$) slower than the other group. There was no difference ($P > .10$) in cell mediated immunity (PHA flank fold thickness change) among the groups. At week 3, the pigs receiving SF for 3 days tended to have a greater flank-fold thickness than those pigs that received SF for 1 day. There was no difference in cell mediated immunity between the control pigs and those fed SF continuously.

Table 2 shows the treatment effect on blood parameters. During Week 1, continuous feeding of SF tended ($P < .13$) to increase polymorphic neutrophils more than feeding the culture for 1 and 3 days. One-day feeding of SF increased ($P < .05$) band cells (immature neutrophils) at Week 1 and this difference tended to remain at Week 3. At Week 1, SF feeding suppressed ($P < .05$) the mononuclear cells compared to the control pigs but at Week 3 continuous SF feeding tended to increase ($P < .05$) the mononuclear cell numbers. It is interesting observation is that there was a difference among litters on Week 1 in the total number of circulating white blood cells.

Weekly and overall average scour scores are shown in table 3. Scour incidence was greatest during Week 1 and SF feeding for 3 days suppressed scours in comparison to the control and continuous-fed group during this period. There was no effect on overall scour scores when averaged over the 3-week trial.

Trial 2. The mortality, performance and cell-mediated immunity results are shown in table 4. Eight pigs died and all had received the SF culture. There was no significant treatment difference in the PHA flank-fold thickness. The controls tended to be lower at Week 3. Differences between litters were seen with respect to weight gains and PHA response at Week 3.

Table 5 shows the blood parameters obtained during the second trial. At Week 1, the control pigs had a higher number ($P < .05$) of lymphocytes compared

to the SF-fed pigs. During Week 3, the 2 groups, which received SF for 3 days at different concentrations, had larger ($P < .05$) packed cell volumes. During this period, total white blood cell counts were higher for all pigs receiving SF compared to the controls. The control group had increased ($P < .05$) levels of lymphocytes. It seems that feeding SF suppressed lymphocyte counts in this experiment.

The effect of SF on scour incidence is shown in table 6. There were no differences during Week 1. Peak in scours for all treatment groups occurred during Week 2, but there was no treatment effect. During Week 3, feeding SF at the different concentrations for 3 days decreased ($P < .05$) scours compared to the controls and continuous SF-fed pigs. Overall, there was no difference between treatment groups on the incidence of scours.

To summarize the 2 trials:

1. There was higher mortality among SF-fed pigs than among the controls.
2. There was no difference in weight gain or feed efficiency between controls and SF pigs.
3. SF tended to increase the cell-mediated immune response, as shown by an increase in flank-fold thickness.
4. Treatment did not affect the incidence of scours.
5. Scour scores did not correlate with weight gains.
6. SF seemed to increase the numbers of polymorphic neutrophils and band cells, while suppressing lymphocyte counts.
7. In trial 2, SF pigs had higher total white blood cell counts.

Therefore, the results of these two trials indicate that feeding Streptococcus faecium to artificially reared pigs does not improve performance.

Table 1. Influence of Streptococcus faecium on Performance and Cell Mediated Immunity (Trial 1)

Item	Treatment				SE[c]
	Control	Continuous	1-day	3-days	
No. pigs initially	14	14	14	14	-
No. pigs died	1	2	4	0	-
Mortality, %	7	14	29	0	-
Weight, lbs:					
Initial[a]	3.82	3.94	3.75	3.81	.17
Week 1	5.33	5.23	4.69	5.23	.22
Week 3	8.14	8.28	7.09	7.72	.29
Feed/gain[b]	1.33	1.37	1.86	1.49	.13
Flank thickness change,mm					
Week 1	3.34	3.52	3.26	3.17	.30
Week 3	4.66	4.60	4.22	5.01	.26

[a]Litter effect ($P < .05$)

[b]Treatment effect ($P < .05$)

[c]Standard error

Table 2. Influence of Streptococcous faecium on Blood Parameters Expressed as Percent (Trial 1)

Item	Treatment				SE
	Control	Continuous	1-day	3-days	
	Week 1				
White blood cells, $10^3/\mu l$[ab]	14.021	14.172	13.558	11.099	1.058
Polymorphic neutrophils[d]	30.8	34.6	23.5	27.2	.03
Mononuclear cells[e]	64.4	58.0	63.1	67.0	.03
Bands[c]	3.7	6.5	12.3	8.0	.02
	Week 3				
White blood cells, $10^3/\mu l$[d]	13.300	13.950	11.673	10.724	1.024
Lymphocytes	43.9	45.0	44.6	45.	.04
Bands[d]	3.5	1.8	4.5	4.1	.01
Monocytes[bd]	7.9	8.8	7.1	9.9	.01

[a]Microliter (10^{-6} liter).

[b]Litter effect ($P < .05$)

[c]Treatment effect ($P < .05$)

[d]Treatment effect ($P < .10$)

[e]Obtained by adding lymphocyte & monocyte together

Table 3. Influence of Streptococcous faecium on Severity of Scours[a] (Trial 1)

Item	Treatment				SE
	Control	Continuous	1-day	3-days	
Week 1[b]	2.87	2.84	2.54	2.37	.16
2	2.45	2.36	2.47	2.15	.16
3	2.04	2.08	2.02	2.05	.04
Overall	2.43	2.44	2.36	2.20	.10

[a]Scores were taken twice a day 1 = none; 2 = semi-solid; 3 = watery. Daily score was derived by adding AM and PM scores.

[b]Treatment effect ($P < .10$)

Table 4. Influence of Streptococcus faecium on Performance and Cell Mediated Immunity (Trial 2)

Item	Treatment				SE
	Control	3-days 1×10^9 CFU	3-days 3×10^9 CFU	Continuous 1×10^6 CFU	
No. pigs initially	14	14	14	14	-
No. pigs died	0	3	3	2	-
Mortality, %	0	21	21	14	-
Weight, lbs:					
Initial[a]	3.21	3.22	3.21	3.26	.11
Week 1[a]	4.47	4.64	4.51	4.61	.18
Week 3[a]	6.11	6.1	.34		
Avg. daily DM intake, g	147	148	140	150	6
Feed/gain[a]	2.47	2.33	2.37	2.54	.30
Flank thickness change, mm					
Week 1	4.1	3.8	4.4	4.4	.2
Week 3[a]	3.6	4.1	4.3	4.3	.4

[a]Litter effect ($P < .05$)

Table 5. Influence of Streptococcous faecium on Blood Parameters Expressed as Percent (Trial 2)

Item	Control	Treatment: 3-days 1×10^9 CFU	3-days 3×10^9 CFU	Continuous 1×10^6 CFU	SE
		Week 1			
Packed cell volume[ab]	30.3	39.6	39.7	40.7	1.0
White blood cells, $10^3/\mu l$[b]	8.3	10.0	8.9	7.9	.7
Lymphocytes[a]	48.9	38.6	40.7	37.4	3.3
Bands	2.9	3.5	2.0	3.6	.7
		Week 3			
Packed cell volume[ab]	37.8	42.5	42.7	38.1	1.1
White blood cells, $10^3/\mu l$[ab]	12.0	17.7	16.6	15.3	1.2
Lymphocytes[a]	43.9	38.7	43.7	43.1	3.7
Bands[b]	5.5	4.6	5.6	4.9	.9

[a]Treatment effect ($P < .05$)
[b]Litter effect ($P < .05$)

Table 6. Influence of Streptococcus faecium on Severity of Scours[a] (Trial 2)

Item	Control	Treatment: 3-days 1×10^9 CFU	3-days 3×10^9 CFU	Continuous 1×10^6 CFU	SE
Week 1	2.03	2.07	2.01	2.00	.03
2	2.17	2.65	2.39	2.50	.15
3[bc]	2.42	2.03	2.18	2.37	.10
Overall[b]	2.20	2.23	2.14	2.26	.05

[a]Scores were taken twice a day; 1 = none; 2 = semi-solid, 3 = watery. Daily score was derived by adding the AM and PM scores.

[b]Litter effect ($P < .05$)

[c]Treatment effect ($P < .05$)