Rhinitis of Swine
XIII. A Possible Relationship Between the Elec trophoretic Pattern of Light and Heavy Birth Weight Pigs and Their Susceptibility to Infection

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The work reported in this paper is part of an investigation into possible reasons for the difference in resistance of light and heavy birth weight pigs to rhinitis under natural conditions. Kristjansson and Gwatkin (1) in earlier work found that an analysis of birth weights of rhinitis-infected pigs and their non-infected litter-mates showed that infected pigs were significantly lighter at birth than their litter-mates which did not contract rhinitis.

Two hundred and thirty-four pigs were examined, 49 had rhinitis and 185 were normal. Infected pigs were found in 22 of 37 litters. They were weighed at 56, 84, 112, 140 and 168 days of age. Differences in weights between normal and infected litter-mates were tested for significance by means of analysis of variance for hierachical classifications, as outlined by Snedecor (2). The differences were all highly significant. In order to determine if these differences were diagnoses differences, and not primarily due to the lighter birth weights of infected pigs, covariance analyses were performed to test the significance of differences between diagnosis means adjusted for birth weight. The infected pigs were still significantly lighter than their unaffected litter-mates.

This is not necessarily true under conditions of experimental trials because the infective dose employed is usually of a massive type in comparison to natural exposure.

It may be considered as established that newborn pigs receive some of their primary specific antibodies from the gamma globulin fraction of colostrum, in which it is rich shortly after farrowing. However, as colostral gamma globulins may contain but a small variety of specific antibodies, their protective power can only be limited, depending on previous experiences of the sow. Because such a defence seems to be inadequate to successfully meet infections alien to the antibody system of the pig, it must be assumed that other means may exist to reinforce its resistance. That this may be the case seems to be indicated in the present report on electrophoretic assays of sera from newborn litter-mates of diverse birth weights which had been kept on the sow for 24 hours before bleeding.

MATERIALS AND METHODS

The experiments were carried out on six litters of newborn pigs, using only those animals in each litter which showed the greatest difference in birth weights, the light ones being usually below 1000 gms. and the heavy ones double that weight. Blood was collected from the anterior vena cava, or by stunning and exsanguination, and the serum was collected by centrifugation as soon as the blood had coagulated. If the serum were not to be used immediately it was stored at —30°C for subsequent analysis.

The protein content of the samples was determined by the method of Gornall et al (3). The sera were diluted before electrophoresis with veronal bu-
fer in the proportions of 1.4 to 2.6 ml. and dialyzed against two changes of the same buffer solution for 24 hours in the cold room. The electrophoretic assays were made in 2 ml. cells by means of the Perkin-Elmer electrophoretic apparatus, Model 38, using veronal buffer of pH 8.6, ionic strength 0.1 and a potential gradient of 10.32 - 1054 volts cm.-1.

RESULTS

The electrophoretic pattern of sera from newborn pigs of the same litter, as it is shown in Figure 1a, is rather similar before suckling. In general, it shows three distinct peaks of various dimensions, representing the three protein fractions of the sera, as albumin, alpha and beta globulin. Since gamma globulin is absent from the blood of newborn pigs it is not recorded by the electropherogram immediately after birth. According to the estimates of Rutqvist (4), carried out on 12 samples by means of paper electrophoresis, the average amount of albumin is 13 per cent, for alpha globulin 68 per cent, and for beta globulin 19 per cent. While no changes occur in the electrophoretic pattern of sera when the pigs are fed artificially for one day with skim milk powder, as is demonstrated in Figure 1b, one day colostrum feeding on the sow is enough to markedly alter the situation. According to the data of Rutqvist (4) the amount of alpha globulin drops under such conditions from its initial value to 29 per cent, while the beta globulin rises to 33 per cent. Gamma globulin enters the pattern as a new factor with an initial value of 25 per cent. The amount of albumin however, seems to be rather stable, at least for several days following colostrum feeding.

Although no similar estimates have been carried out in present assays, the recorded differences between the electrophoretic patterns of sera from light and heavy birth weight pigs appears to be noticeable enough to show a proportional measure of their respective protein fractions.

Electrophoresis of sera from one day old colostrum-fed heavy weight pigs shows a pattern which in its general features comes close to the one indicated by Rutqvist’s data referred to above. According to Figure 2a the peak

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**Fig. 1**

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A

\[ \text{Ascending electrophoretic pattern of sera from newborn pigs (a) before suckling (b) following a 24 hour period of a 10 per cent skim milk powder regime} \]

B
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of albumin is still incompletely developed, whereas the one of the beta globulin component, representing the most conspicuous fraction of piglet sera at this time, overrules the peaks of alpha and gamma globulin. The electropherogram of sera from light litter mates on the contrary, displays a marked reduction of beta globulin, its peaks in many instances being lower than that of alpha globulin. Pigs showing the lightest body weight exhibit the smallest peak of beta globulin, while it reaches a moderate high or matches that of the alpha globulin component in animals of an intermediate weight, as can be seen from Figures 2b and 2c. On the other hand, the peaks which represent albumin and gamma globulin components in the electropherograms seem to be comparable in both weight groups of animals. The pattern-difference between the two weight groups seems to be observable for at least 4 consecutive days following colostrum feeding; then the pherograms of both groups become more or less similar.

**DISCUSSION**

The demonstrated changes which occur in the electrophoretic pattern of sera from newborn piglets following one day colostrum feeding on the sow are in their general features in agreement with the findings of other workers (4, 5, 6). Most of the investigators however, directed their attention predominantly to the gamma globulin component of the electrophoretic serum pattern because of its relationship to antibodies. It is believed that the ingested colostral antibodies are mainly responsible for the temporary resistance of piglets against infectious diseases. According to the estimates of Staub and Boguth (5) the amount of gamma globulin increases rapidly to a high level in the first days of colostrum feeding, decreasing gradu-
ally during a six week period, and then rising again to a constant level.

Since present electrophoretic assays were based on a short colostral feeding period in which body weight differences of newborn pigs were carefully considered, changes of relatively short duration could be compared with each other revealing in this way a birth weight dependence of the beta globulin component in the sera examined.

The significance of serum beta globulin is only partially understood as yet, though its role in the transport and exchange of soluble fat substances is known. Since properdin, a protein responsible for the destruction of bacteria and neutralization of viruses, is a normal constituent of beta globulin (7) it may be conjectured that concentration differences in beta globulin would also represent differences in the concentration of properdin.

If this conjecture could be confirmed by other techniques it might point the way to an understanding of the differences in susceptibility of light and heavy birth weight pigs to rhinitis, and possibly other infections.

SUMMARY

In a preliminary study of possible causes for the greater susceptibility of light over heavy birth weight pigs to natural infection with atrophic rhinitis, it was found that there were marked differences between the alpha and beta globulin peaks in the two groups. Light birth weight pigs, usually below 1000 grams, showed a marked alpha and lower beta globulin peak, whereas pigs of double that birth weight displayed a reversed pattern, the beta globulin peak being the pronounced one while the alpha globulin peak appeared to be decreased. The significance of these findings may lie in the fact that properdin, an anti-bacterial and virus-neutralizing globulin, is to be found in the beta globulin fraction of the serum.

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RESUME

Une étude préliminaire a été faite sur les causes possibles de la susceptibilité des jeunes porcelets à l'infection naturelle par la rhinite atrophique. Les porcelets légers à la naissance étaient beaucoup plus susceptibles que les porcelets d'un poids lourd. On remarqua qu'il y avait des différences profondes entre les niveaux d'alpha et beta globulines chez les deux groupes. Ceux d'un poids léger à la naissance, ordinairement de moins de 1000 grammes, présentaient un fort niveau de globuline alpha et une baisse dans celui de la beta. Des porcs deux fois plus lourds lors de la naissance présentaient un patron électrophorétique inverse, le niveau de la globuline beta était plus prononcé et il semblait y avoir une baisse dans la globuline alpha. On croit qu'il s'agirait là du fait que la properdine, une globuline anti-bactérienne et vire-neutralisante se trouve dans la fraction globulinaire beta du sérum.

REFERENCES