Proceedings of the Iowa Academy of Science

Volume 40 | Annual Issue Article 135

1933

A Preliminary Study of the Reaction of Two Disease Resistant Stocks of Chickens after Infection with Their Reciprocal Pathogens

W. V. Lambert
Iowa State College

A PRELIMINARY STUDY OF THE REACTION OF TWO DISEASE RESISTANT STOCKS OF CHICKENS AFTER INFECTION WITH THEIR RECIPROCAL PATHOGENS [1] [2]

W. V. LAMBERT

In another publication the writer (1) pointed out that five generations of selection for resistance to fowl typhoid in the chicken resulted in a decided decrease in the mortality of the selected stocks. Specifically, the effect of the selection was to decrease the mortality from approximately 85 percent in the unselected parental stock to slightly more than 10 percent in the fifth selected generation.

While these studies clearly show the efficacy of selection for resistance to a bacterial disease they do not, unfortunately, give us any clue as to the causes for this increased resistance. The results of Webster (5) on mice and of Lewis and Loomis (3 and 4) on guinea pigs suggest that resistance to disease may be due in part, at least, to non-specific factors. Webster's data indicate that resistance of mice to a para-typhoid enteritidis infection helps to protect them against mercuric bichloride poisoning. Lewis and Loomis pointed out that the capacity of inbred strains of guinea pigs to produce hemolytic antibodies against beef and sheep corpuscles, and agglutinins for *Eberthella typhi* and *Brucella abortus* is imperfectly correlated with resistance to a tuberculosis infection; furthermore, that the families showing the greatest resistance to tuberculosis also appeared to be "somewhat more resistant to one or more phases of the anaphylactic reaction complex."

Since *Salmonella gallinarum* (causative bacterium of fowl typhoid) and *Salmonella pullorum* (causative agent of bacillary white diarrhea in the chick) are closely related organisms, the writer decided to test the reaction of the stock selected for resistance to fowl typhoid to an *S. pullorum* infection. In addition, as a stock of chickens having a high resistance to *S. pullorum* infection had been developed by Dr. Elmer Roberts at the University of Illinois, it was possible to test chicks from this stock for their resistance to *S. gallinarum*. Through the courtesy of Dr. Roberts, an exchange of breeding stock was made in 1929, and the above

1 Presented at the meeting of Iowa Academy of Science, April, 1932, Cedar Falls, Ia.
2 Paper No. 50 from the Department of Genetics, Iowa State College, Ames, Iowa.

mentioned tests were carried out in 1930. The birds of the fowl typhoid resistant stock at that time had been selected three generations for resistance, while the *S. pullorum* resistant chicks probably represented somewhat more selection. The results of these tests are shown in Table I.

These results indicate that a greater inherent resistance to *S. pullorum* infection existed in the typhoid resistant stock than in the unselected control stock tested concurrently. Tests for significance of the observed difference in mortality between the two stocks show the difference to be significant, the value of P being less than 0.01. These results represent the combined totals from six separate trials.

In these tests all chicks were injected intraperitoneally with a dose of $12x10^7$ *S. pullorum* bacteria suspended in 0.5 cc. of physiological saline solution. In preliminary trials this dosage was found to be lethal for about 90 percent of the birds of the unselected stock. The culture of *S. pullorum* was secured from Dr. J. R. Beach of the Veterinary Science Division of the University of California, and these tests were carried out in Dr. Beach's laboratory.[3]

The number of chicks tested from the bacillary white diarrhea resistant stock was 55, of which group 43 died. In the control series of 48 chicks, 40 died. The respective percentage mortalities were 78 and 83. The difference of 5 percent is not statistically significant. The results of these tests are shown in Table I.

All chicks of the *S. pullorum* resistant stock were infected intraperitoneally with a doze of $12x10^6$ *S. gallinarum bacteria* suspended in 0.5 cc. of physiological saline solution. This was the standard dose used in infecting all chicks of the fowl typhoid resistant stock, and during three years it had caused a mortality above 85 percent in the unselected or control chicks. The control birds for the latter stock were White Plymouth Rock chicks from the flock of the Poultry Husbandry Department, Iowa State College. These data are the totals from six separate trials.

The mortality rates for the selected and the control stocks for each phase of the experiment are shown in figure 1, together with the mortality rates observed in the control birds tested concurrently. In each case the selected chicks showed a slower mortality rate than the controls, although this difference was slight in the *S. pullorum* resistant chicks.

[3] The writer is indebted to Dr. J. R. Beach and to the late Dr. W. A. Lippincott, former head of the Poultry Husbandry Division, University of California, for placing the facilities of their laboratory at his disposal.

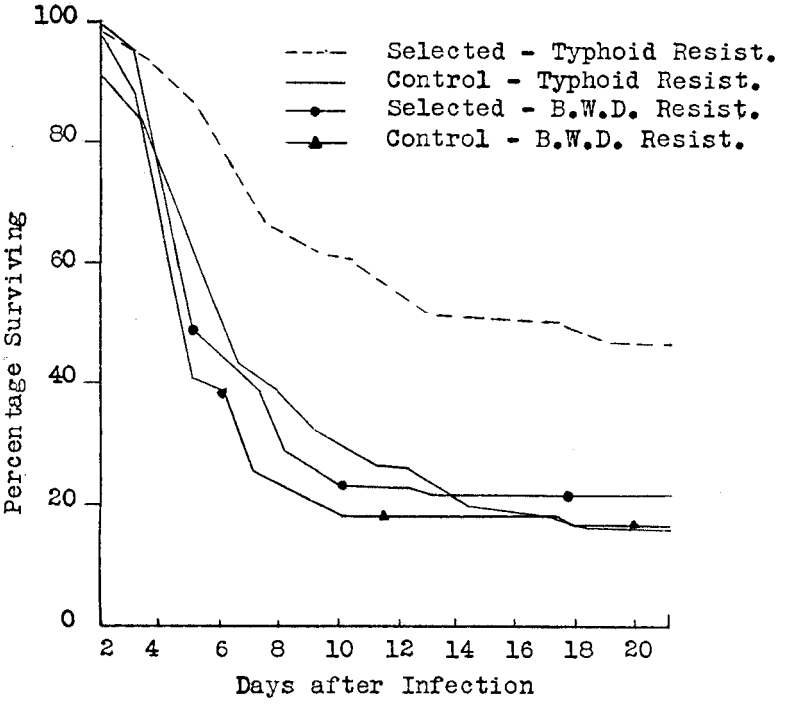

Fig. 1. Mortality rates in (1) fowl typhoid resistant stock after infection with *S. pullorum* and (2) in bacillary white diarrhea resistant stock after infection with *S. sanguinarium*, with their respective controls.

Discussion

While the above data are too few to be conclusive, they indicate that selection for resistance to one pathogen affords some protection to infection with a closely related one. This would suggest that resistance is to some extent due to non-specific factors, since it is improbable that the toxic products of one bacterial species are identical with those produced by even a closely related form. In this respect the findings are in general agreement with the observations of Webster (5) and Lewis and Loomis (3 and 4).

The writer cannot suggest any evident reason for the greater resistance of the typhoid resistant stock to *S. pullorum* and, on the contrary, the high susceptibility of the bacillary white diarrhea resistant stock to *S. gallinarum* infection. One possible explanation might be that the typhoid resistant chicks came from surviving parents, while the *S. pullorum* resistant stock did not. Dr. Roberts shipped baby chicks to the writer in 1929 and these were sent to the range without being submitted to test. They were the parents of birds tested in 1930 (Table I). In the light of results secured

in other phases of the experiment, however, this explanation certainly would not seem to account for the entire difference (see Lambert and Knox, 2).

Table I. The reaction of fowl typhoid resistant chicks to S. pullorum *infection, and of pullorum resistant chicks to infection with* S. gallinarum. *The control stock came from unselected flocks and represented in each case the same breed as the resistant stock*

Stock Selected for Resistance to:	Resistant			Control [3]		
	No. of Chicks Infected	No. Dying	Percent Dying	No. of Chicks Infected	No. Dying	Percent Dying
S. gallinarum [1]	97	54	55	97	84	86
S. pullorum [2]	55	43	78	48	40	83

1 White Leghorns.
2 White Plymouth Rock stock secured from Dr. E. Roberts.
3 Different strains of the same breed in each case.

Another possible explanation may be that all the chicks of the *S. pullorum* stock came from one male mated with nine females, while the typhoid resistant stock were from six males each mated with several females. Sires vary greatly in their ability to transmit resistance, and it may have been that the sire of the *S. pullorum* chicks was lacking in factors for resistance, or that his genotype did not complement well those of the females with whom he was mated.

While the results reported herein are inconclusive, they suggest the need for further studies of this nature. However, such experiments should be conducted only after stocks are produced that react in a more uniform manner to one pathogen than do those that are now available.

LITERATURE CITED

1. Lambert, W. V. 1932. Natural resistance to disease in the chicken. I. The effect of selective breeding on natural resistance to fowl typhoid. Jour. Immun. 23: 229-240.
2. Lambert, W. V. and Knox, C. W. 1932. Selection for resistance to fowl typhoid in the chicken with reference to its inheritance. Iowa Agr. Exp. Sta. Res. Bul. 153: 261-295.
3. Lewis, P. A. and Loomis, D. 1925. Allergic irritability. II. Anaphylaxis in the guinea pig as affected by the inheritance. Jour. Exp. Med. 41: 327-335.
4. ———. 1928. IV. The capacities of guinea pigs to produce antibodies as affected by the inheritance and as related to familial resistance to tuberculosis. Jour. Exp. Med. 47: 437-448.
5. Webster, L. T. 1924. Microbic virulence and host susceptbility in paratyphoid-enteritidis infection of white mice. III. The effect of selective breeding on host resistance. Jour. Exp. Med. 39: 879-886.