Fowl Cholera Immunization in Turkeys

III. Significance of Market Quality in the Evaluation of Fowl Cholera Vaccines

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Turkeys vaccinated with various experimental vaccines and a commercial bacterin for fowl cholera and surviving an artificially induced epornitic were killed, and their carcasses were examined for wholesomeness. It was evident that, if the "fitness for human consumption" judgment was considered in addition to mortality, efficacy ratings of the various vaccines changed. This suggests that the "fitness for human consumption" factor be considered in future evaluation of biologicals for use in meat-producing birds.

The efficacy of fowl cholera immunizing agents is measured in terms of "living or dead." The official testing agency of veterinary biologics passes or fails fowl cholera immunizing agents on the basis of a comparative testing scheme. In this scheme, unvaccinated turkeys measure the lethality of the challenge dose, whereas vaccinated turkeys measure the protective capacity of the immunizing agent to the same dose. This permits consideration to be given to the magnitude of the challenge when deciding upon the efficacy of a fowl cholera bacterin/vaccine (Standard Requirements for Pasteurella avicida Bacterin and Combination Bacterins Containing Pasteurella avicida (multocida), September, 1968). The same yardstick of "living or dead" is also applied in experimental studies dealing with fowl cholera immunizing agents (2, 4–7, 8).

Obviously, the question of "living or dead" is of primary importance when deciding upon the efficacy of any vaccine/bacterin. However, when dealing with the efficacy of vaccine/bacterins to be used in a population of subjects whose primary purpose is to be wholesome for human consumption, the quality of the carcass of a bird surviving an epornitic is of equal importance. On this basis, it is advisable to include a "fitness for human consumption" factor in the evaluation of fowl cholera immunizing agents. This study was designed to determine whether the inclusion of this "fitness for human consumption" factor influences the evaluation of biologics of this type.

MATERIALS AND METHODS

In an experiment dealing with the immunizing properties of various cell fractions of Pasteurella multocida (P-1059), 1,500 Beltsville white turkeys were exposed to artificially created epornitics. These epornitics were induced by putting the test population in contact with artificially infected turkeys. On the basis of survival, judgments were made as to the efficacy of the immunizing agents employed. These agents were cell wall, cytoplasm, culture filtrate, culture filtrate (blood-agar), combination, and a commercial bacterin. With the exception of the commercial bacterin, these materials were administered in three vehicles: 50% Freund Incomplete Adjuvant, alum (0.5%), and saline (0.85% NaCl). Each cell fraction, in each vehicle, was employed at four different concentrations. The lower concentrations of the cell fractions and the commercial bacterin were ineffective. Therefore, all comparisons are confined to the undiluted preparations (3). Because of the magnitude of this experiment, it was conducted in two separate trials.

At the conclusion of the 30-day challenge period of each trial, all surviving turkeys were killed and necropsied, and the lesions of fowl cholera were noted. Applying the criteria of the Poultry Inspection Service of the U.S.D.A. to these carcasses, they were adjudged "fit" or " unfit" for human consumption. Briefly, the criteria of un wholesomeness which would make a carcass unfit for human consumption would be any evidence of an infectious process. Common indicators of infectious processes would be toxicemia or septicemia. Toxemia is manifested by petechial or ecchymatic hemorrhages on the serous surfaces of visceral organs and septicemia is manifested by accumulations of purulent exudate in the body cavities. This scoring was done by an individual

1 Paper no. 756, Institute of Comparative Medicine, University of Georgia, Athens, Ga. 30601.
TABLE 1. Effectiveness of various cell fractions of Pasteurella multocida (P-1059) as vaccines in groups of turkeys* challenged by a homologous experimental epornitic lasting for 30 days when the “fitness for human consumption” factor is included (trial I)

| Fraction         | Vehicle      | Deaths | Degree of protection | Condemned | Total | Degree of protection | Difference degree of protection |
|------------------|--------------|--------|-----------------------|-----------|-------|----------------------|---------------------------------|
| Cell wall        | Alum (0.5%)  | 9      | %                     | 2         | 11    | 27                   | -8                              |
|                  | Freund (50%) | 9      | 35                    | 2         | 10    | 28                   | +10                             |
|                  | Saline       | 7      | 46                    | 2         | 9     | 35                   | -9                              |
| Cytoplasm        | Alum         | 11     | 22                    | 2         | 13    | 13                   | -9                              |
|                  | Freund       | 6      | 45                    | 4         | 10    | 28                   | -17                             |
|                  | Saline       | 10     | 22                    | 3         | 13    | 6                    | -16                             |
| Culture filtrate | Alum         | 8      | 43                    | 1         | 9     | 40                   | -3                              |
|                  | Freund       | 11     | 0                     | 2         | 13    | 6                    | +6                              |
|                  | Saline       | 3      | 77                    | 6         | 9     | 35                   | -42                             |
| Commercial bacterin | Freund    | 8      | 27                    | 3         | 11    | 22                   | -5                              |

* Fifteen turkeys per group.

a Abbots’s formula (1).

* Freund Incomplete Adjuvant.

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TABLE 2. Death and condemnation pattern in the negative controls of trials I and II*

| Expt  | Vehicle | No. of deaths | Deaths (%) | Condemned | Total | Dead or condemned |
|-------|---------|---------------|------------|-----------|-------|-------------------|
|       |         |               |            |           |       |                   |
| Trial I| Alum    | 14            | 93         | 1         | 15    | 100               |
|        | Freund  | 11            | 73         | 3         | 14    | 93                |
|        | Saline  | 13            | 87         | 1         | 14    | 93                |
|        |         | 14            | 93         | 1         | 15    | 100               |
| Trial II| Alum    | 13           | 87         | 0         | 13    | 87                |
|        | Freund  | 12            | 80         | 0         | 12    | 80                |
|        | Saline  | 15            | 100        | 0         | 15    | 100               |
|        |         | 13            | 87         | 0         | 13    | 87                |

* Fifteen turkeys per group.

b The mean in trial I was 86%, and in trial II it was 87%.

c The mean in trial I was 96%, and in trial II it was 87%.

d Freund Incomplete Adjuvant.

* No treatment.

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trained by the Poultry Inspection Service, U.S.D.A., in an attempt to keep the scoring process uniform. To prevent bias, the turkeys were not identified until all scoring had been completed.

A modification of Abbott’s formula was used in computing the effectiveness of the vaccines (1). In our computations, X = per cent dying during the challenge period plus per cent condemned as unfit for human consumption in the appropriate control group; Y = per cent dying during the challenge period plus per cent condemned in an experimental vaccine group. For example, the total of the deaths and condemnations in the positive control group of turkeys inoculated only with Freund Incomplete Adjuvant were compared to the experimental groups which used Freund Incomplete Adjuvant as the vaccine vehicle. Then $X - Y$ = the per cent effectiveness of the vaccine. The “degree of protection” was calculated from the formula $(X - Y/X) 100$.

**RESULTS**

On the basis of turkeys surviving the challenge in trial I, the culture filtrate fraction in the saline vehicle was adjudged to be 77% protective. When the “fitness for human consumption” factor is included, however, the previous judgment becomes invalid, since the degree of protection is at the 35% level (Table 1).

This reduction in protective capacity is generally the case in the immunized groups of trial I.
TABLE 3. Effectiveness of various cell fractions of Pasteurella multocida (P-1059) as vaccines in groups of turkeys challenged by a homologous experimental epornitic lasting for 30 days when the "fitness for human consumption" factor is included (trial II)

| Fraction                 | Vehicle | No. of deaths | Degree of protection | Condemned | Total | Degree of protection | Difference degree of protection |
|--------------------------|---------|---------------|----------------------|-----------|-------|----------------------|--------------------------------|
| Culture filtrate         | Alum (0.5%) | 15            | %                    | 0         | 15    | (15)                 | 0                              |
|                          | Freund (50%)^d | 7             | 41                   | 0         | 7     | 41                   | 0                              |
|                          | Saline   | 7             | 53                   | 2         | 9     | 40                   | -13                            |
| Combination              | Alum     | 3             | 77                   | 0         | 3     | 77                   | 0                              |
|                          | Freund   | 3             | 75                   | 2         | 5     | 59                   | -16                            |
|                          | Saline   | 4             | 73                   | 1         | 5     | 67                   | -6                             |
| Culture filtrate (blood-agar) | Alum | 13            | 0                    | 0         | 13    | 0                    | 0                              |
|                          | Freund   | 7             | 41                   | 1         | 8     | 34                   | -7                             |
|                          | Saline   | 15            | 0                    | 0         | 15    | 0                    | 0                              |
| Commercial bacterin      | Freund   | 4             | 66                   | 1         | 5     | 59                   | -7                             |

^a Fifteen turkeys per group.
^b Abbott's formula (1).
^c Negative degree of protection.
^d Freund Incomplete Adjuvant.

Additionally, in the negative control group of trial I, the mean death rate rose from 86 to 96% when the condemnation factor was included in the computation of death rates (Table 2).

In trial II, the application of the "fitness for human consumption" factor did not have such a striking effect on the results. In the groups of turkeys immunized with the combination fraction in all the vehicles, changes due to the fitness factor were minimal (Table 3).

DISCUSSION

There were obvious differences in pathology in the two trials. In trial I, the clinical symptoms, death pattern, and lesions observed were suggestive of a chronic infection. This was not true in trial II, in which these factors were suggestive of an acute infection.

The data in general bear out the contention that the "fitness for human consumption" factor should play a role in the evaluation of the fowl cholera biologicals. The practical importance of the death of a bird due to fowl cholera is obvious, but of equal importance to the turkey producer is the market quality of the survivors of the epornitic. From the producer's point of view, early death is preferable to the continued maintenance of a turkey which will be condemned and, as a result, will be valueless.

The differences in pathology observed in the trials may be due to two factors. The first may be the different climatic conditions existing during the separate challenge periods. The weather during trial I was normal, early summer for the area. In contrast, the challenge period for trial II was marked by a severe heat wave in its early stages. The second factor to be considered is that the birds in trial I entered an uncontaminated facility at the time of challenge. In trial II, the same facility was used unchanged from its contaminated condition at the end of trial I. It would seem, then, that the birds in trial II received a harsher challenge combined with a severe environmental stress. These facts may account for the chronic infection found in the birds in trial I and the acute infection found in the birds in trial II.

The striking differences in results between trial I and trial II, when the "fitness for human consumption" factor is considered, suggest that, in future testing of vaccine potency, consideration should be given to this factor in the evaluation of biologicals to be used in meat birds.

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