Efficacy of commercial inactivated *Salmonella* vaccines in quail

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A B S T R A C T

This work aimed to evaluate the efficacy of a commercial inactivated *Salmonella* vaccine in quails where sixty of three weeks old quails were vaccinated twice via subcutaneous route while another forty birds were kept without vaccination as non-vaccinated control. The immune response of vaccinated birds was estimated by microagglutination test for *Salmonella* Enteritidis (SE) and *Salmonella* Typhimurium (ST) antibodies that revealed a detectable increase in antibody titers in vaccinated birds in comparison with the unvaccinated ones. The protection rate of vaccinated quails post challenge with locally isolated *Salmonella* Enteritidis (SE) and *Salmonella* Typhimurium (ST) strains were 83.3% and 90% respectively. *Salmonella* was recovered from vaccinated challenged quails at ratio ranged from 23.3% -33.3% for SE and 20% - 30% for ST from the heart blood, liver, spleen and caecal junction post challenge. The results of challenge test showed that vaccinated quails were effectively protected against virulent strains of *Salmonella* Enteritidis (SE) and *Salmonella* Typhimurium (ST).

Key Words: *Salmonella*, vaccine, quail.

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1. INTRODUCTION

Salmonella infection is one of the most important bacterial diseases affecting poultry industry especially in intensive systems of rearing. Such infection has a public health importance indicating a need to control *Salmonella* infection in poultry (Barrow et al., 1999) and any contributions for organism elimination in birds could have a major influence in reduction of its populations under natural conditions (Davies and Breslin, 2004). Control of Salmonellosis in poultry by immunity, whether acquired or innate, is a possible means of containing the problem. Many different serotypes of *Salmonella* have been isolated from quails, most of them have a public health significance, but some include *S. Typhimurium, S. Enteritidis* and *S. gallinarum* that could cause considerable losses in quails of less than a few weeks of age (Sander et al., 2001). Widespread usage of antibiotics has led to the emergence of multiple antibiotic-resistant bacteria **(**Gast et al., 2004 a, b**)**. Control of Salmonellosis in poultry is posing itself as one of the difficult problems not only for those who are concerned with poultry industry, but also for public health hazard because of the fact that most of the serovars of *Salmonella* which poultry harbour can act as potential pathogens for human, this problem has indicated an increasing requirement for effective vaccines to control this important zoonotic infection (Methner et al., 2006 and Barrow, 2007). Both live attenuated and inactivated vaccines are available where live vaccines induce better protection than inactivated ones while inactivated vaccines appeal more to producers and regulators because they do not pose the possible public health risk that accompany the use of live vaccines (Barrow, 2007).

The objective of the present work is to evaluate the efficacy of the commercial inactivated *Salmonella* vaccine in immunizing and protecting quails against experimental *Salmonella* infection.

2. MATERIAL AND METHODS

2.1. Avian Salmonellosis vaccine:

Commercial oil inactivated *Salmonella* vaccine prepared from S. Typhimurium and S. Enteritidis strains was used for vaccination of quails.

2.2. Salmonella strains:

Local isolates of *S. Typhimurium and S. Enteritidis* isolated from infected poultry were obtained from Veterinary Serum and Vaccine Research Institute (VSVRI), Abbasia, Cairo, Egypt. These isolates were used for experimental challenge of vaccinated quails.

2.3. Quails:

One hundred, three weeks old quails were obtained from the farm of Faculty of Agriculture, Cairo university, Egypt. These quails were used to evaluate the potency of inactivated *Salmonella* vaccine. These birds were tested and found to be free from *Salmonella* infection and antibodies as determined serologically. All birds were housed under hygienic measures in separate isolates receiving balanced ration and adequate water.

2.4. Mice:

A total of 250 Swiss Albino mice of about 15-20 g body weight supplied by Veterinary Serum and Vaccine Research Institute, were used for determination of LD_{50} of S. Typhimurium and S. Enteritidis strains.

2.5. Potency test:

One hundred quails at 3 weeks old were divided as follow: 60 quails were vaccinated with the vaccine with 2 doses each of 0.5 ml inoculated subcutaneously in the dorsal aspect of the neck with 3 weeks interval depending on the recommended dose according to manufacturer instructions. 40 quails were kept without vaccination as control. All birds were housed in separate isolates under hygienic measures receiving adequate ration and water. Serum samples were obtained weekly from all birds to follow up the induced antibody levels.

2.6. Challenge test:

Vaccinated and non-vaccinated control quails groups (each group was divided into two subgroups) were challenged two weeks post the 2nd dose with the virulent S. Typhimurium and S. Enteritidis strains using 0.1ml of 10^8 colony forming units/ml inoculated intramuscularly (Adriaesen, et al., 2007).

2.7. *Serological evaluation of humeral immune response of the vaccinated quails by Micro-agglutination test (MAT):*

This test was carried out to estimate *Salmonella* antibodies in vaccinated birds as described by Thaxton et al. (1970) and Brown et al. (1981). The geometric mean ST antibody titers were calculated according to Brugh (1977).

2.8. Recovery of Salmonella strains from challenged quails:

On the 4th week post challenge, samples were collected from the heart blood, liver, spleen and caecal junction from vaccinated and non-vaccinated challenged quails for recovery of the organism.

3. RESULTS

During the present work, a commercial oil inactivated *Salmonella* vaccine was successfully used to vaccinate quails against *Salmonella* Enteritidis and S. Typhimurium infections, where the humoral immune response was evaluated in vaccinated quails by microagglutination test as demonstrated in (Table 1). The Geometric mean of *Salmonella* antibody titers against SE and ST strains in sera of vaccinated birds were detectably increased from [6] and [7] pre-vaccination to reach [343] and [422], respectively at the 5th week post vaccination with inactivated *Salmonella* vaccine, while the control unvaccinated birds showed steady levels [6-9].

Concerning the protection efficacy of *Salmonella* vaccine, (Table 2) showed that the protection rate was 83.3% and 90% in vaccinated quails when challenged with virulent SE and ST strains, respectively, while the control unvaccinated group was unable to withstand the experimental infection with virulent SE and ST strains confirming that the vaccine was effectively potent and hence able to protect quails against infection. On the other hand, (Table 3) showed that the *Salmonella* Enteritidis and S. Typhimurium organism could be recovered from vaccinated challenged quails with commercial inactivated *Salmonella* vaccine at ratio from 33.3% - 23.3% for SE and 20% - 30% for ST from heart blood, liver, spleen and caecal junction on the 4th week post challenge, while these ratios were 75- 90% from control unvaccinated birds.

4. DISCUSSION

Salmonella infections in poultry are probably the most important source of *Salmonella*-associated food-poisoning in human and the contribution of different species to human infection bears some relationship to the quantity of meat from each species that is consumed. Consumption of poultry meat is much greater in some countries where the incidence of human infection was originated from this source (Barrow, 2007). Incidence of human infection arising from consumption of duck meat is likely to be much greater as it is with human infection arising from chickens (Methner et al., 2006). Accordingly, the present study aimed to answer the question about to any extent quails could be protected against *Salmonella* infection? And parallel to this respect how aid to minimize *Salmonella* infection in man? During the present work, a commercial oil inactivated *Salmonella* vaccine was successfully used to vaccinate quails against *Salmonella*

Table (1): *Salmonella* Enteritidis (SE) and Typhimurium (ST) antibody titers in quails sera as measured by microagglutination test

Quails Groups	Strain used	Geometric mean of *Salmonella* antibody titers on periods post vaccination					
		Prevacc.	1 WPV	2 WPV	3 WPV	4 WPV	5 WPV
Vaccinated	SE	6	28	57	75	226	343
	ST	7	43	70	92	299	422
Control	SE	8	7	8	7	8	9
	ST	6	7	6	8	6	7

Prevacc: Pre-vaccination WPV: weeks post vaccination

Table (2): Protective efficacy of inactivated Salmonella vaccine against challenge with virulent Salmonella Enteritidis (SE) and S. Typhimurium (ST) strains

Quail Groups	Challenge strain	No. of challenged quails	No. of survived quails	Protection Rate
Vaccinated	SE	30	25	83.3%
	ST	30	27	90%
Control	SE	20	9	45%
	ST	20	8	40%

Table (3): Recovery of Salmonella strains from challenged quails

Quail Groups	Challenge strain	Number of positive samples for *Salmonella* recovery			
		Heart blood	Liver	Spleen	Caecal junction
Vaccinated	SE	7/30 (23.3%)	8/30 (26.7%)	9/30 (30%)	10/30 (33.3%)
	ST	6/30 (20%)	7/30 (23.3%)	7/30 (23.3%)	9/30 (30%)
Control	SE	15/20 (75%)	16/20 (80%)	15/20 (75%)	15/20 (75%)
	ST	16/20 (80%)	17/20 (85%)	18/20 (90%)	18/20 (90%)

Enteritidis and S. Typhimurium infections. The Geometric mean of *Salmonella* antibody titers against SE and ST strains in sera of vaccinated birds detectably increased at 5th week post vaccination while the control unvaccinated birds showed steady levels.

Concerning the protection efficacy of *Salmonella* vaccine, the protection rate was satisfactory potent in vaccinated quails when challenged with virulent SE and ST strains, while the control unvaccinated group was unable to withstand the experimental infection with virulent SE and ST strains confirming that the vaccine was effectively potent and hence able to protect quails against infection. These results came in agreement with previous report ((Uytteroek et al., 1989; Nakamura et al., 1994) and Barrow, (2007) who recommended the use of formalized inactivated oil emulsion *Salmonella* vaccine for protection of poultry against infection. On the other hand, the *Salmonella* Enteritidis and S. Typhimurium organism could be re-isolated from vaccinated challenged quails with commercial inactivated *Salmonella* vaccine from heart blood, liver, spleen and caecal junction on the 4th week post challenge by a lower ratio than from control unvaccinated birds

These results agreed with that Salmonella vaccine protects against experimental challenge with shedding of the organism on the same period with declined rate post challenge with indication that the highest incidence of the organism is that in the caecal junction ((Uytteroek et al., 1989 and Timms et al., 1990)

So, it could be concluded that the vaccination studies performed here showed that quails immunized with two doses of inactivated *Salmonella* vaccine were protected to a high degree against challenge with the same pathogenic *Salmonella* strains.

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