



Effect of zinc on the humoral immune response of piglets after classical swine fever virus vaccination

S K KAR¹, D K SARMA², P MEDHI³, M NATH⁴ and S BORAH⁵

Assam Agricultural University, Khanapara, Guwahati, Asom 781022 India

Received: 5 March 2012; Accepted: 26 April 2012

Key words: Antibody, CSF, Indirect-ELISA, Pig, Zinc

Zinc is among the trace minerals which play multifarious activity in various biological functions supporting life (Yousef *et al.* 2002). Influence of zinc on the immune system is well described (Prasad 2000, Goswami *et al.* 2005). Studies pertaining to immunologic mechanisms whereby zinc modulates increased susceptibility to infection were conducted and found that individuals deficient in zinc experience increased susceptibility to a wide variety of pathogens (Shankar and Prasad 1998). Importance of zinc in pig nutrition though recognized since 1955 (Tucker and Salmon 1995), but little work has been undertaken on the immunomodulatory effects of zinc, and no work has been undertaken to see the effects of zinc on the antibody response of pigs after swine fever virus vaccination. Classical swine fever (CSF) is most devastating viral disease of pigs and the disease is a concern in most of the pig producing states particularly the North Eastern states of India (Sarma *et al.* 2008). The presently available lapinized vaccine against the disease in India is producing low level of antibody and the protective immunity is found to decline after 6 months in most of the vaccinated pigs. Occurrence of CSF in vaccinated pigs was also reported (Barman *et al.* 2003, Sarma 2007). It is desirable to maintain optimum level of antibody in the piglets to protect against CSF. Therefore, the present study was designed to see the effect of dietary supplementation of zinc on the humoral immune response of piglets after CSF vaccination.

One-month old Tamworth and Desi (T&D) crossbred piglets (30) of both the sexes were selected for the study. While grouping care was taken to include pigs from the same litter. All experimental pigs were kept under uniform feeding and managerial practices at college of farm for 60 days. The animals were equally divided into 3 groups A, B and C having 10 animals in each group. Animals of the groups A

and B were fed with the diet containing zinc sulphate (ZnSO_4) @150 ppm for 60 days. Animals of the group C was given normal diet without the zinc supplementation. Animals of the groups A and C were vaccinated with cell culture adapted lapinized vaccine virus strain, obtained from the ICAR National Fellow Project Laboratory, College of Veterinary Science, Khanapara, Guwahati and having virus titer of $3.5 \log$ 10/dose (1 ml) intramuscularly on the 56 days i.e at the weaning age. Animals of the group B were not given the vaccine. Serum samples from all the piglets were collected on the day of vaccination (56 days of age) and after 1 month of the vaccination (86 days of age). All the serum samples were tested for CSF virus antibodies by indirect ELISA as per Sarma and Sarma (1996) with slight modifications. The modification was made with the coating antigen in which cell culture propagated CSF virus was used as antigen using 1:250 dilution in the coating buffer. Statistical analysis (ANOVA test) was done using the corrected OD values of the serum samples from the 3 groups as per Snedecor and Cochran (1994).

Our results revealed that zinc supplementation @150ppm in the diet of the piglets and vaccination has no adverse effect on the growth as the piglets receiving the zinc containing diet without vaccine (group B) showed similar growth. Increase of antibody in the serum samples of all the piglets (group A and group C) fed with the diet supplemented with or without zinc, respectively, along with the vaccine was observed. The mean OD value (1.065 ± 0.039) was more in the serum samples of the piglets fed with zinc and receiving the vaccine (group A) than the mean OD value (0.654 ± 0.064) in the serum of piglets of group C and the mean of the OD values of the 2 groups differed significantly ($P < 0.05$). No significant increase ($P < 0.05$) of antibody level against CSF vaccine virus in the serum samples of the control piglets (group B) was observed and the OD value (0.160 ± 0.073) was almost same at 56 days and at 86 days of age (Table 1).

Strategies aiming at boosting natural host defense particularly by the use of immune-modulators are currently attracting a greater level of attention. Micronutrient like zinc

Present address: ¹M.V.Sc.Scholar, Animal Biotechnology (dr.soumyakar@gmail.com), ²ICAR National Fellow (email:dksarma1956@gmail.com), ³ Senior Research Fellow (Veterinary Microbiology), ⁴ Research Associate (AICRP on Pigs), ⁵Senior Research Fellow (Veterinary Physiology).

Table 1. OD values against CSF virus in the serum samples of the 3 groups of piglets

Groups of the piglets	Mean±SE
Control (group B)	0.160±0.073 ^a
Vaccination without Zn (group C)	0.654±0.064 ^b
Vaccination with Zn (group A)	1.065±0.039 ^c
CD (5%) = 0.168, CV (%) = 24.249	

Means with different superscripts differed significantly from each other.

has significant influence on immune function and it is essential for all the enzymes involved in the cell proliferation. Zinc is crucial for normal development and function of cells mediating nonspecific immunity such as neutrophils and natural killer cells. Reduction in antibody titre against Newcastle disease and Marek's disease virus was reported in zinc deficient chicks (Zhang and Zhou 1998, Zhang *et al.* 1999). On the other hand enhanced antibody response in the chicks was observed when zinc fortified diet was given (Stahl *et al.* 1989).

Since continuous cell proliferation (B and T cells) takes place in the immune system to produce immunoglobulin and cytokines, zinc may play an important role in modulating the immune system. Both primary and secondary antibody responses were also reported to be depressed in zinc deficient mice (Prasad 1998). Higher magnitude of antibody response was also recorded by feeding zinc fortified diet in poultry (Pimentel *et al.* 1991). There are reports that zinc deficiency may increase susceptibility to a variety of pathogens and studies have shown that zinc deficiency caused an imbalance between TH1 and TH2 functions, which are essential for antibody production. The present findings are in agreement with the findings of the other workers on the influence of zinc on the immune response and the findings of the present study will be useful to evolve an effective vaccination strategy against CSF to obtain higher level of antibody in pigs than the conventional way of vaccination.

SUMMARY

Study on effect of zinc on the humoral immune response of piglets after classical swine fever virus vaccination was conducted on piglets and it was seen that significant increase of antibody level specific to classical swine fever (CSF) virus was observed in serum samples of Tamworth and desi crossbred piglets (10) after feeding of diet containing zinc sulphate @150ppm for 60 days from 1 month age and vaccination at 56 days of age with cell culture adapted lapinized CSF virus strain, as compared to the antibody level in the serum samples of piglets (10) of same breed and age group receiving the vaccine and diet without zinc. Control group of piglets (10) receiving zinc in the diet and no vaccine

has not showed any rise of the antibody. This is the first report on the influence of zinc on the humoral immune response of pigs after CSF virus vaccination and the findings of the study may be useful in evolving effective vaccination regime against CSF for piglets.

ACKNOWLEDGEMENT

The authors thank the Principal Scientist, AICRP on Pigs, Assam Agricultural University, Khanapara, Guwahati for extending cooperation to carry out the trial. The financial assistance from the ICAR, New Delhi, is duly acknowledged.

REFERENCES

- Barman N N, Nath A J, Hazarika M P, Barman B and Thakuria D. 2003. Outbreak of classical swine fever in regularly vaccinated pig herd. *Indian Journal of Comparative Microbiology Immunology and Infectious Diseases* **24**: 89–90.
- Goswami T K, Bhar R, Jadhav S E, Joardar S N and Ram G C. 2005. Role of dietary zinc as nutritional immunomodulator. *Asian-Australian Journal of Animal Sciences* **18**: 439–52.
- Pimentel J L, Cook M E and Gregor J L. 1991. Immune response of chicks fed various level of zinc. *Poultry Science* **70**: 947.
- Prasad A S. 1998. Zinc and immunity. *Molecular and Cellular Biochemistry* **188**: 63–69.
- Prasad A S. 2000. Effects of zinc deficiency on Th1 and Th2 cytokine shifts. *Journal of Infectious Diseases* **182**: S62–8.
- Shankar A H and Prasad A S. 1998. Zinc and immune function: the biological basis of altered resistance to infection. *American Journal of clinical nutrition* **68**: 447–63.
- Sarma P C and Sarma D K. 1996. Use of ELISA for detecting HCV antibodies in vaccinated piglets. *Indian Journal of Animal Sciences* **66**: 1128–31.
- Sarma D K. 2007. Occurrence of classical swine fever in vaccinated pigs. *The Vets Communications* **1**: 32–33.
- Sarma D K, Lal Krishna and Misri J. 2008. Classical swine fever in pigs and its status in India: A review. *Indian Journal of Animal Sciences* **78**: 1311–17.
- Snedecor G W and Cochran W G. 1994. *Statistical Methods*. 8th edn. Oxford and IBH Publishing Co., New Delhi.
- Stahl J L, Cook M E, Sunde M L and Greger J L. 1989. Enhanced humoral immunity in progeny chicks from hens fed practical diets supplemented with zinc. *Applied Agricultural Research* **4**: 86–89.
- Tucker H F and Salmon W D. 1955. Parakeratosis or zinc deficiency disease in the pig. *Proceedings Social of Experimental Biology Medicine* **88**: 613–16.
- Yousef M I, ElHedny HA, El-Demerdash F M and Elagamy E I. 2002. Dietary zinc deficiency induced changes in the activity of the enzymes and the level of free radicals, lipids, protein electrophoretic behaviour in growing rats. *Toxicology* **175**: 223–34.
- Zhang R and Zhou Y. 1998. The effect of zinc on immune function in animals. *Animal Science Abroad* **25**: 3–8.
- Zhang R, Zhou Y and Yang H. 1999. The modulation effects of zinc on immune organs development and functions in broiler. *Acta Veterinaria Zootechnica Sinica* **30**: 504–12.