Vet.Med.J.,Giza. Vol.53, No.4. (2005):971-980.

THE EFFECT OF MATERNALLY DERIVED ANTIBODIES ON THE RESPONSE OF CALVES TO VACCINATION AGAINST KABETE O RINDERPEST VACCINE

A.M. AL-SUKAYRAN**, A.A.EL- BANNA**, S. M. HAFEZ** and M. A. FARAG***

* Department of Foot and Mouth Disease, Veterinary Serum and Vaccine Research Institute, P.O. Box 131, Abbassia, Cairo - Egypt.

** National Agriculture and Water Research Center, P.O.Box 17285, Riyadh 11484.

Received: 7.7.2005

Accepted: 30.7.2005.

SUMMARY

A study was undertaken to find out the age at which calves borne to repeatedly vaccinated dame could be vaccinated against rinderpest (RP). Eight vaccination regimes on eight groups of colostrum-fed calves were implemented using a local live attenuated cell culture RP vaccine. The animals of regimes 1,2,3,4,5,6,7 and 8 were primary vaccinated at the age of 1,2,3,4,5,6,7 and 8 month respectively and boosted at the age of 6,7and 9 month in regimes 1 to 5 and at 9 months in regimes 6,7 and 8. Maternally derived antibody (MDA) and vaccine-induced antibody against rinderpest antigen were assessed using competitive ELISA and the detected antibodies are expressed as percent inhibition (PI) values. The sera that had PI below 42 tested negative. Two days following feeding colostrum calves revealed highest PI (94.5-92.2). MDA gradually declined to undetectable levels by the age of 4 to 6 months. Early vaccination regimes before the age of 6 months were ineffective. Higher antibody levels were detected at the age of 7 months in the animals of regimes 1,2,3,4,5 and one month after primary vaccination in regimes 6,7 and 8. Based on the above finding, it is recommended that the colostrum fed calves could be vaccinated against Rinderpest when they are at 6 to 7 months of age.

Keywords: Rinderpest, Competitive ELISA, Vaccination, Calves, and MDA, Saudi Arabia.

INTRODUCTION

The programs of immunization of calves born to repeatedly vaccinated dams are considered a complex problem in which control of rinderpest (RP) relies predominantly on vaccination. In Saudi Arabia heifer calves are vaccinated at 6 months of age and revaccinate annually together with the whole herd (Hafez et al., 1985). Bull calves are

vaccinated at the first 2 weeks of age before soled to the feedlot farms and then at 6 months of age (Anon, 1993). Hafez et al., 1997 reported that only 17% (128 of 734) of bull calves (5-10 months old) had antibodies against rinderpest virus. In this connection, most of the recent outbreaks of RP in Saudi Arabia were reported in feedlot farms (Anon, 1993 &1999). Competitive ELISA has been developed for seromonitoring of pos-vaccinal immunity aggainst RP (Anderson, 1991, Joint FAO-IAEA 1992 & 1993). Bovine neonate depends on MDA as acquired immunity (Smith & Little 1922 and Stott et al., 1979). The degree of immunity has been equated with the immunoglobulin concentration in calf serum at the completion of colostrum 1g absorption (Penhale et al., 1973 Nicholls et al., 1984, Black & Rweyemau; 1984; Gopalan & Padmanabhan, 1985; Ata et al., 1989, Economides, 1991; Ramesh-Babu & Rajasekhar, 1992; Van Mannen et al., 1992; Amri, 1996).

The effect of MDA on suppressing the neonate immune system has been reported in calves (Clover & Zarkower, 1980; Nicholls et al., 1984). The blocking effects of MDA constitute the most important cause of failure of RP vaccination in cattle (Wafula & Wamwayi, 1989; Ramesh-Babu & Rajasekhar, 1992). The aim of this study is to investigate the interference by MDA with active immunization on systemic production of Ig in calves vaccinated against RP (Kabete O strain of attenuated RP virus) at different ages after birth in an attempt to define the appropriate age at which calves could be primary vaccinated.

MATERIALS & METHODS

Animals:

A total of 72 zero day old Friesian-Holstein female calves were fixed in a large dairy farm in Al-Kharj area, in the Central Region of Saudi Arabia. The calves were born to cows previously vaccinated against RP,3, months before calving. Eight groups of calves 9 animals in each were implemented. All calves were fed colostrum as a source of MDA, at least for 2 days after birth.

Calves vaccination:

Calves vaccinated against RP using a local produced live cell culture RP vaccine (Kabete O strain of attenuated RP virus) with a dose of 1-ml administrated subcutaneously according to the following schedule:

Calves in regimens 1,2, 3, 4, 5, 6, 7 and 8 were vaccinated at the age of 1, 2, 3, 4, 5, 6, 7 and 8 month respectively, and boosted at the age of 6,7 and 9 month in regimens 1 to 5. Whereas, calves in regimens 6,7 and 8 boosted at 9 month of age.

Serum samples:

Serum samples from each calf tested were collected on day zero and two days after birth, then every month for a period of 10 months. Serum samples were also stored at - 20°C until they were analyzed.

Competitive Enzyme Linked Immunosorbent Assay (ELISA):

Antibodies against rinderpest antigens were detected in serum samples using competitive ELISA (Anderson et al., 1991 & Joint FAO/IAEA Program 1993). The levels of antibody are expressed as percent inhibition (PI) values. ELISA kit and the relevant software were obtained through the Program of the Animal Production and Health Section of the Joint FAO/ International Atomic Energy Agency (IAEA) Division of Nuclear Techniques in Food and Agriculture (M. H. Jeggo and J. Anderson, Personal communication).

Assay Procedure:

The assay was performed according to the direction indicated in the bench protocol supplied with the RP competitive ELISA kit (Bench Protocol, Version - RPV 1.3, Joint FAO/ IAEA Program, Animal Production and Health, July, 1993), and in accordance with the methods reported by Crowther & Smith (1987) and Crowther (1995).

RESULTS

Results of sera collected from zero day old calves tested by competitive ELISA and represented by Percentage inhibition (PI) were considered the negative population. The mean PI value of the negative population was 23 Table 1. The mean PI of the negative population plus 2X stander deviation (23+2X9.6=42) is consider the positive cut-off point (Crowther, 1997, personal communication) Table1. PI of MDA detected in sera collected from all calves two days after feeding colostrum were 94.5 to 92.2 respectively (Table 1). The results of mean PI obtained from the tested sera collected from all groups of calves during the first 8 months of age are shown in Table 2. The decay and decline in PI of MDA in all groups started during the first month of age and continued up to 6 to 7 months (Figs 1& 2). The majority of the non-vaccinated calves up to the fifth month of age remained detected MDA, but most of vaccinated and non-vaccinated calves had negative MDA by the age of 6 months. The levels of antibody detected at the age of 7 month in calves vaccinated before that age were not significantly different from each other. At the age of 8 month, calves showed significantly higher RPV antibody levels compared to the levels at age 6 and 7 months. The mean PI levels detected in the sera collected from all groups tested (1 to 8) resulted from primary and boosting vaccination at the age of 8,9 and 10 months are shown in Figs (1&2).

Table (1): Percentage inhibition (PI) values detected in claves sera of the eight groups (9 calves in each from vaccinated dams) at zero day and two days following feeding colostrum

calf No.	Regimen 1		Regimen 2		Regimen 3		Regimen 4		Regimen 5		Regimen 6		Regimen 7		Regimen 8	
	Zeo	2D	Zeo	2D	Zeo	2D	Zeo	2D	Zeo	2D	Zeo	2D	Zeo	2D	Zeo	2D
1	20	94.5	9	92.2	8	93.2	33	92.4	34	93.1	29	92.4	38	92.6	24	92.5
2	29	92.6	14	93.2	27	92.8	31	93.1	9	94.4	13	94.5	36	93.6	23	92.2
3	22	94.2	18	92.7	19	93.1	22	93.1	24	94.2	9	93.1	6	92.4	33	93.6
4	24	92.6	39	92.5	33	94.2	29	93.8	27	94.1	25	93.1	45	94.2	20	94.3
5	19	93.1	22	94.5	33	94.3	26	92.2	33	92.8	25	92.7	16	94.4	6	93.4
6	8	92.7	6	92.2	22	94.3	31	992.8	19	94.3	36	92.3	24	92.8	12	94.5
7	33	94.5	28	94.1	19	94.2	29	92.5	28	92.2	22	93.5	16	92.3	3	94.5
8	11	92.8	8	94.2	8	92.2	21	94.2	17	92.4	3	92.5	15	92.6	29	93.3
9	8	92.6	25	92.7	23	92.4	26	94.1	33	93.3	22	92.6	24	92.4	23	92.7

Zeo: Zero: Percentage inhibition (PI) value detected in calves sera at zero day-Mean = 23& SD=9.6
2D: two days: Percentage inhibition (PI) value detected in calves sera at two days following feeding colostrum ranged from 92.2 to 94.5.

Table (2): Mean Percentage inhibition (PI) values detected in sera of calves of the eigh regimens (9 calves in each) collected from the first to ten month of ages vaccinated by RP vaccine.

RP antibody levels represented as Percent inhibition (PI) detected in sera collected from calves of the eight regimens from one to ten months of ages										
Regimen	Age in month									
	1	2	3	4	5	6	7	8	9	10
1	88.38*	81.25	82.38	63.80	66.00	60.00	46.88	78.50	80.29	89.29
2	88.91	82.27*	80.46	59.00	49.73	32.64	40.73	80.46	83.00	89.64
3	89.30	82.50	79.10*	57.90	45.60	33.44	28.33	80.44	84.30	90.67
4	88.60	84.10	80.36	70.38*	51.10	40.90	51.40	77.20	81.56	91.50
5	87.35	86.22	78.75	74.89	23.22*	39.11	51.44	77.33	79.56	85.89
6	82.7	82.66	78.40	72.90	54.80	42.16*	41.40	57.40	88.25	89.83
7	87.00	84.89	75.00	66.22	54.25	47.00	39.42*	79.38	86.25	87.75
8	86.17	85.17	76.00	70.00	60.33	38.66	48.60	51.16*	90.50	86.33

* Time of prime vaccinatioon in each regimen

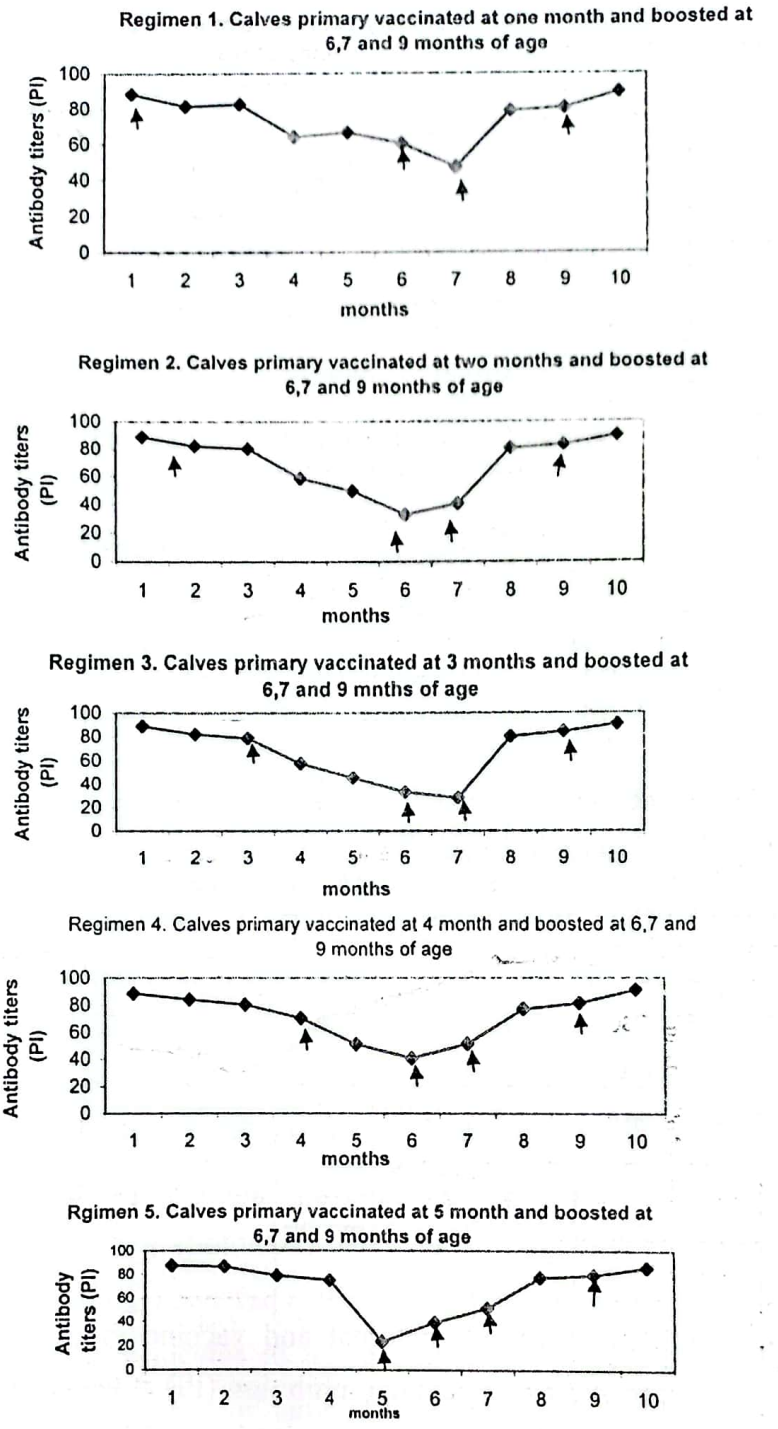

Fig. (1): Mean titers of maternal derived and vaccine induced antibodies expressed as percentage inhibition (PI) detected in calves sera of regimens 1,2,3,4 and 5.

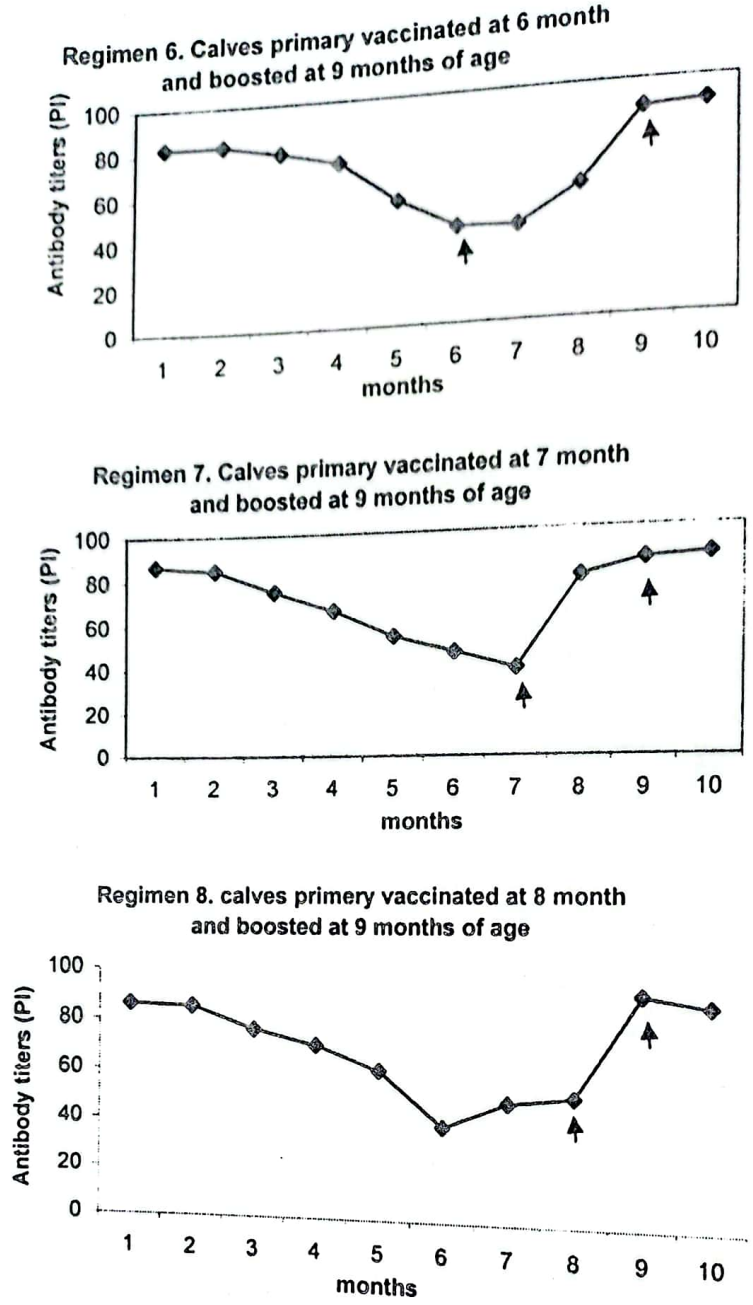

Fig. (2): Mean titers of maternal and vaccine induced antibodies expressed as percentage inhibition (PI) detected in calves sera of regimens 6,7 and 8.

DISCUSSION

Many investigators explained the efficacy of MDA in providing protection against diseases also observed its effect in preventing the response of young animals to active vaccination (Nicholls et al., 1984; Francis & Black, 1986; Ramish-Babu & Rajasekhar, 1992; Kitching &Salt, 1995 Farag et al., 1998 and Rahman et al., 2002). The author of competitive RP ELISA (Crowther, 1997, personal communication) considered percentage inhibition (PI) detected in calves sera at zero time of age were negative populations (Mean PI =23). Calves primary vaccinated between the age of 1 to 5 months showed rapid decay of MDA. Acceleration the rate of decay of MDA led to relatively shorter half-life and time of waning of MDA (Nicholls et al., 1984). The mechanisms of MDA suppression are unknown. Several investigators proposed models to explain this mechanisms such as: rapid captures of the vaccine antigen by MDA (Solomon, 1971, Uhr and Moller, 1968). As a result of possible mediation by iso-and idiotope specific suppressor T lymphocytes (Solomon,1970, Flood et al., 1986., and Okumura and Tada,1986). MDA act directly on B lymphocytes to down-regulate the proliferation required for antibody production (Massirio et al., 1988). MDA complexed with vaccinal antigen may act through a regulatory network to either suppress antigen specific TH1 cells or actively up-regulate the production of an antigen specific T suppressor cell population (Harte and Playfair, 1983). Suppression of B and T lymphocyte responsiveness due to the transfer of immunosuppressive factors in colostrum such as cortisol, histamine and cytokines (Clover & Zarkower, 1980). Plowright & Taylor, 1967; Nicholls et al., 1984. Ahmed, 1990, Farag et al., 1998 found that calves with MDA did not merely fail to respond to vaccination but their antibody titers were depressed and this depression was related to the level of pre-existing MDA at the time of vaccination. Experiments with calves and piglets born of non-vaccinated dams as well as previously vaccinated or infected dams have clearly shown that MDA is the most important factor causing a poor response to vaccination (Ahl & Wittmann 1987; Black et al., 1984; Nicholls et al., 1984; Francis & Black, 1986; Panjevic, 1986). Positive response against RP vaccine occurred when calves vaccinated after 6 months of age. The inability of calves to respond to vaccination before that age could be due to the degree of development and/or maturity of the immune system (Sadir et al., 1988), or the different parts of the complete immune system do not become functional simultaneously (Kitching & Salt, 1995). By the age of 7 month all calves responded positively and vigorously when vaccinated against RP, it could be due to that calf's immune system has reached full maturity to react against RP or waning of MDA at the time of vaccination. The rise in serum antibody levels observed in calves following vaccination at age of 7 months or older

was not interrupted by further vaccination, only the rate of rise in antibody levels was generally reduced after age 8 months. Revaccination of calves in regimen 8 at age 9 months had any real enhancement effect on antibody levels. Furthermore, by age 10 months, all calves in the different experimental groups showed very similar serum RPV antibody levels, regardless of the time of vaccination or the number of vaccinations they received. Accordingly, the obtained results revealed that, colostrum fed calves could be primary vaccinated against RP between the age of 6 and 7 months. This finding agree with Ahmed (1990) and Srour & El-Zein (1986). Srour & El-Zein (1986) reported that in Middle Eastern countries it seems advisable to vaccinate calves against RPD at the age of 6 to 8 months, and revaccinate the calves at the age of 7 to 9 month, then revaccinate yearly.

It could be concluded from the obtained results that:

1- both passively acquired colostral antibodies (MDA) and age are important factors in the response of young calves to vaccination against RP vaccine.

2- Least interference of MDA and full response of the immune system to the RP vaccination in calves occur between age 6 to 7 months, and it is recommended that the colostrum-fed calves be vaccinated against RP when they are 6 to 7 months old. Vaccination before that age would be wasteful.

3- The ELISA method employed and PI values can be used to monitor the antibody titers in calves.

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