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### Original Paper

## The efficacy of both locally prepared vaccines against foot and mouth disease in cattle in Monofeya governorate

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### ABSTRACT

The accurate diagnosis of FMD is important for eradication and controlling of disease in endemic countries involving Egypt. Vaccination was the only approach to control the FMD disease in Egypt. This study was carried out for investigation and identification of vaccination by governorate and prevailing local vaccines in cattle sera in Monofeya governorate during the period from October 2018 to May 2019. 130 serum samples were tested for FMDV. 30 samples were used as control, 50 samples collected from animals received local governorate vaccine and 50 samples from animals received local prevailing vaccine. 49 out of 130 serum samples (37.7%) were positive and 81 out of 130 serum samples (62.3%) were negative for NSP (nonstructural protein). Results were (0.0), 3(3.7%) pre-vaccination and 27 (33.33%), 18(22.22%) 1<sup>st</sup> MPV- 25(30.86%), 18 (22.22%) 2<sup>nd</sup> MPV-15 (18.52%), 13 (16.05%) 3<sup>rd</sup> MPV and (0.0), 9 (11.11%) 4<sup>th</sup> MPV for serotype A. For serotype (O): 9 (11.1%), 10 (12.4%) pre-vaccination- 36 (44.44%), 28 (34.56%) 1<sup>st</sup> MPV-33(40.74%), 27 (33.33%) 2<sup>nd</sup> MPV-24(29.63%), 20(24.7%) 3<sup>rd</sup> MPV-14(17.3%), 12 (14.80%) 4<sup>th</sup> MPV. For serotype (SAT2): 4 (4.9%), 24 (4.93%) pre-vaccination-30 (37.03%), 21 (25.93%) 1<sup>st</sup> MPV-27(33.33%), 21 (25.93%) 2<sup>nd</sup> MPV- 18 (22.22%), 14(17.3%) 3<sup>rd</sup> MPV-3 (3.71%), 4 (4.93%) 4<sup>th</sup> MPV. In Conclusion. FMD controlling requires vaccines that will supply disparity of infected from vaccinated animals.

## 1. INTRODUCTION

Foot and mouth disease (FMD) is an important transboundary disease that upsets cloven-footed animals in Africa and Asia Sobhy *et al* (2018). FMD virus include seven separate strains (A, O, C, Asia-1, and South African territories [SAT] 1–3) also numerous subtypes reflecting substantial inherited inconsistency in each serotype (Ferris *et al* 2009). Foot and mouth disease virus serovars O, A and Asia-1 -1 are responsible for FMD epidemics in the Middle East and serotypes O and A are commonly spread in North Africa (Knowles *et al* 2012). In Egypt from 1964 to 2005, only serotype O was recognized, however in 2006, FMDV serotype A outbreak was occurred in cattle and FMDV serotype (A) was recognized as A/Egy/2006 and this strain has in excess of 90% nucleotide distinctiveness with A/KEN/98, A/ETH/92, and A/KEN/05, and all topotypes are closely associated. It is though overview in Egypt from East Africa was perhaps during imported live cattle from Ethiopia (through sea-route) Ahmed *et al* (2012). Serovars O, A and SAT-2 strains were renowned in this country since 2013 (Sobhy *et al* 2018). FMDV strains O, A, and SAT-2 were commonly affecting buffalos and cattle in different Egyptian governorates at a period in the summer of 2017. FMDV is transboundary from neighbor countries or thorough the importation of carrier animals (Zeedan *et al* 2020).

The current study planned to detect the protection of different local vaccines used in Egypt filed by detection of antibody titers in serum samples collected from cattle in Monofeya governorate during the years of 2018 and 2019.

## 2. MATERIAL AND METHODS

### 2.1. Serum samples:

one hundred and sixty sera were obtained from periodically vaccinated cattle from Monofeya Governorate and used for screening of FMD nonstructural protein antibodies using ID Screen® FMD NSP Competition ELISA test and detection of antibody titers for serotypes (O, A and SAT2) by FMDV serotyping ELISA KITS. The Serum samples collected from vaccinated and non-vaccinated animals as follow:

1. Fifty serum samples were collected from cattle received governorate local vaccine and 15 serum samples were used as unvaccinated control.
2. Fifty serum samples were collected from cattle received prevailing local vaccine and 15 serum samples were used as control.

### 2.2. The vaccination trial (types of viral vaccines):

1. Local governorate FMD vaccine Polyvalent inactivated FMD vaccine Batch No. 1702. Exp. date 08/2019, It includes:  
Inactivated FMD virus serotype A/EGY/1+2012(A Iran05) 106 TCID50 per dose

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Inactivated FMD virus serotype O/EGY-4-2012(O Panasia2) 106 TCID50 per dose

Inactivated FMD virus serotype SAT2 EGY-A-2012) (Sat 2)106 TCID50 per dose

The vaccine is water in oil emulsion and is given 3ml /dose subcutaneous.

2. Locally prevailing produced Vaccine used Tri-Aphthovac® contained A Iran05, O Pan Asia2 and SAT-2 Egypt serotypes Batch No. 1706080201. Vaccine with oil adjuvant and is given 2ml /dose subcutaneous.

### 2.3. ELISA Kits:

2.3.1. ID Screen® FMD NSP Competition ELISA kit:

2.3.2. Solid-phase competitive ELISA (SPCE) for antibodies against FMDV serovars O, A and SAT 2:

Calculation of results

$$\text{Inhibition \%} = 100 - (\text{serum OD} / \text{reference OD}^*) \times 100$$

\* Reference OD = mean OD of 4 wells handled with the negative Control

### 2.4. Preparation of collected samples:

All samples were prepared according to (OIE, 2012).

## 3. RESULTS

### 3.1. Seroprevalence of FMDv non-structural protein antibodies:

3.1.1 Demonstration of nonstructural protein antibodies in cattle sera pre inoculation with local governorate and local prevailing vaccines. 49 out of 130 serum samples (37.7%) were positive and 81 out of 130 (62.3%) were negative for NSP as shown in Figure (1).

3.1.2 Demonstration of non-structural protein antibodies in Monofeja governorate in October 2018 in cattle vaccinated by inactivated prevailing local vaccine:

8 out of 30 (26.6%) were positive and 22 out of 30 (73.4%) were negative for NSP as shown in Figure (1).

### 3.2. Demonstration of specific FMDv antibodies in cattle pre and post vaccination with governorate local and prevailing local vaccines:

#### 3.2.1 Demonstration of specific antibodies in cattle sera pre-vaccination

The serotyping of FMD antibodies in animals received local governorate vaccine, antibodies were 9 (11.1%) and 4 (4.9%) for FMD serotype O and SAT2 respectively, while animals received prevailing local vaccine, antibodies were 3(3.7%), 10 (12.4%) and 24 (4.93%) for FMD serotype A, O and SAT2 respectively Figure (2).

#### 3.2.2 Demonstration of specific antibodies in cattle sera 1<sup>st</sup> month post vaccination:

In animals received local governorate vaccine, antibodies were 27(33.33%), 36 (44.44%) and 30 (37.03%), while animals received prevailing local vaccine, antibodies were 18(22.22%), 28(34.56%) and 21(25.93%) for FMD serotype A, O and SAT2 respectively Figure (2).

#### 3.2.3 Demonstration of specific antibodies in cattle sera 2<sup>nd</sup> month post vaccination:

In animals received local governorate vaccine, antibodies were 25 (30.86%), 33(40.74%) and 27 (33.33%), while

animals received prevailing local vaccine, antibodies were 18(22.22%), 27(33.33%) and 21(25.93%) for FMD serotype A, O and SAT2 respectively Figure (2).

#### 3.2.4 Demonstration of specific antibodies in cattle sera 3<sup>rd</sup> month post vaccination:

In animals received local governorate vaccine, antibodies were 15 (18.52%), 24(29.63%) and 18 (22.22%), while animals received prevailing local vaccine, antibodies were 13 (16.05%), 20 (24.7%) and 14 (17.3%) for FMD serotype A, O and SAT2 respectively Figure (2).

#### 3.2.5 Demonstration of specific antibodies in cattle sera 4<sup>th</sup> month post vaccination:

In animals received local governorate vaccine, antibodies were 14(17.3%) and 3(3.71%) for FMD serotype O and SAT2 respectively, while animals received prevailing local vaccine, antibodies were 9(11.11%), 12(14.80%) and 4(4.93%) for FMD serotype A, O and SAT2 respectively Figure (2).

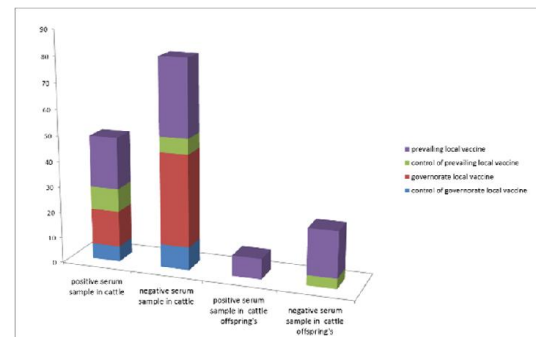


Figure 1 ID Screen® FMD NSP Competition ELISA to detect FMDV nonstructural protein antibodies in cattle and their offspring's sera pre inoculation with local governorate and local prevailing vaccines.

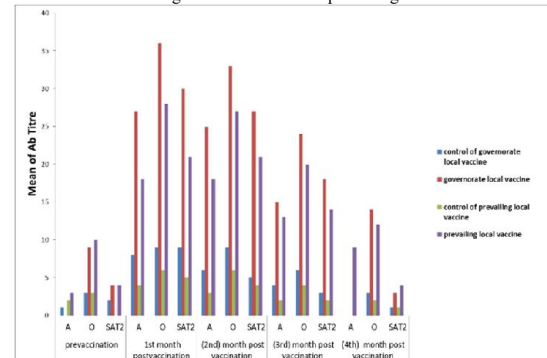


Figure 2 Mean antibodies titer in vaccinated cattle with governorate local and prevailing local vaccines by ELISA

## 4. DISCUSSION

For accurate control programs, the demonstration of the serotype complicated in field epidemics has to be recognized within laboratories. ELISA test is faster but less variable, quantitative results and is not dependent on cell-culture capabilities. The application of NSP tests after vaccination of animals is dependent on using purified, inactivated vaccine that is free (as much as is possible) of NSPs. Differentiation of diseased and immunized animals is essential for suitable eradication of FMD by vaccination and improvement of transporter animals due to immunization (Utenthal *et al.*, 2010).

We used ID Screen® FMD NSP Competition ELISA kit for the discovery of FMDv non-structural protein (NSP)

antibodies in serum obtained from cattle and their offspring's for differentiation of infected from immunized animals. Antibody reaction against FMD viral non-structural proteins was extensively used for this aim. Our results shown in Figure (1), were agreed with those of Lamya *et al.*, (2017) who detected (37.7%) antibodies against FMD NSP in cattle sera. Also, Raof *et al.*, (2011) documented 27.1% in cattle and 35.7% in buffaloes. Moreover, these results agreed with kitching, (2002) and Hiam, (2005) mentioned that animals that have improved from natural infection will gain antibodies against NSP result from the virus replication in the tissue, these proteins will be expressed and encourage the creation of host specific antibodies. The recognition of antibodies can be used to identify FMD infected animals which may still live virus.

Our results were approved with that of Brocchi *et al.*, (2006) reported that FMDv nonstructural protein have conventional substantial care in recent years, with exploration to improve serological tests for FMDV. Our results disagreed with those of El Daous *et al.*, (2016) who detected (56.67%) antibodies against FMD NSP in cattle sera.

Our result in Figure 2 were agreed with Lamya *et al.*, (2017) who stated that cattle received polyvalent inactivated FMD vaccine, (governorate local vaccine), antibodies were (24.2%), (29.5%) and (16.1%) 2 WPV for FMD serotype A, O and SAT2, respectively. The results agreed with results obtained by El-Bagoury *et al.*, (2014). Animals may be persistently infected with FMD after challenge with live FMD virus. Inactivated FMD virus vaccine persuades structural proteins antibodies only. (Clavijo *et al.*, 2004). Inactivated FMD vaccines are vital component for control and eradication policies both in endemic and free areas (Valarcher *et al.*, 2008).

Abd El-Rhman *et al.*, (2020) was used solid-phase competitive ELISA, which indicate the circulation of serovars O, A, and SAT2 between cattle as 52.2, 17.4, and 30.4%, respectively, while buffaloes were 31.8%, 27.3%, and 40.9%, respectively. These results are agreed with Diab *et al.*, (2019) who identified the same 3 serotypes between cattle. Abd El-Rhman *et al.* (2015) Who stated that, serotype "O" was commonly isolated from cattle and buffaloes in Egypt. Strain "O" responsible for in excess of 60% of the FMD epidemics worldwide. Mahapatra, and Parida, (2018). In our study, negative NSPs of FMDV sera were inspected to estimate defensive level of governorate and prevailing local vaccines in addition to FMDV serovars A, O and SAT2 antibody titer. It is sustained by Abd El-Rhman *et al.*, (2015) who verified 60.77% between immunized cattle and 76.65% between immunized buffaloes. On the other hand, Shabana (2009) stated immunization in Egypt could defend 63% of animals, 20% of animals under risk, and 17% of animals still subject to infection; this may be because of FMDv serotype SAT2 was officially recorded 2012.

Vaccination is the actual way for disease control and prevent the extent of the disease (Mahapatra and Parida, (2018); Depa *et al.*, (2012)). Consistent immunization of ruminant in contradiction of FMD in Egypt, has become significant effort to continue animal production and to decrease financial costs Knight-Jones *et al.*, (2015), but not inhibit carrier state Ma *et al.*, (2011). The current vaccine is inactivated trivalent FMD vaccine of serotypes (Diab *et al.*, 2019); of antigenic mass 6.5, 6.2, and 5.9, respectively Hussein *et al.*, (2015). To induce the allowed protection in immunized animals, Daoud *et al.*, (2013). Jamal *et al.*, (2013) recorded those low immune replies (low defensive antibody titer) against FMDV by the nearby created vaccines. Defense discussed by the vaccine is serotype-

specific (Diab *et al.*, (2019), this disturbs the submission of vaccine in the field (Mahapatra and Parida, (2018); Mahapatra *et al.*, (2016)), This agrees with Diab *et al.*, (2019) and Ahmed *et al.*, (2012) who done phylogenetic analysis for virus strains recovered from cattle in Egypt as well as Valdazo-González *et al.*, (2015) who identified FMDv variety particularly SAT2, which is include 14 topotypes. Depending on the efficiency appraisals, vaccination is providing high herd immunity levels for disease control without extra control measures Knight-Jones *et al.*, (2014).

The ELSA results revealed that serotype O is the dominant strain during 2018 (97.5%) in cattle. These results agreed with Abd Algayed *et al.*, (2018) stated that serotype O is the dominant strain during 2017 (94.9%) and serotypes A (56.8%) is more prevalent during 2016, while SAT2 had been reported in small percentage; 5.4% and 4.08% during 2017 and 2016, respectively. Also, these results agreed with previous Egyptian studies which showed that FMDV O, A, SAT2 serotypes were responsible for 2012 outbreak Salem *et al.*, (2012). Ibrahim, (2015) concluded that the protection subsequent vaccination is similar to that subsequently natural infection, but its length is somewhat shorter. A single immunization of inactivated vaccine will defend against experimental challenge for 3-6 months. The length of immunity is precious by the type of adjuvant, antigenic mass and constancy used in the vaccine formulation.

## 5. CONCLUSION

Our study highpoints current serological situation of FMD in Egypt and it clarify the submission of immunization program in governorates needs to be improved. Additional work is essential to determine the correctness of the current serotype A, O and SAT2 vaccines to defend from the presently isolated viruses. As vaccination does not prevent carrier state especially in buffalo's population vaccination alone is improbable to control the disease. Our studies provide useful information to help monitor the Egyptian field FMDV cases where the vaccination programs are adopted to control the disease using A, O and SAT2 serotype vaccine. Therefore, it is highly recommended to continue the update of vaccine strains to comprise the present circulating serotypes of FMDV with incessant monitoring of the genetic variations in viruses from different locations inside Egypt. Moreover, the co-spread of A, O and SAT2 serotypes and topotypes into Egypt can pose an increased threat of emergence of new variants.

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