Thermostabilization of proteins with lyophilization is well understood. Moreover, technologies to thermostabilize alum-adjuvanted protein subunit vaccines without inducing undue agglomeration or aggregation have also been demonstrated (WO2008/118691 and WO2012/158978). However, alum is less effective at stimulating cell-mediated immune responses and is not therefore sufficient for all vaccines. The nano-emulsion adjuvant CoVaccine-HT has been previously tested as a prepared liquid emulsion (Blom et al., Sucrose fatty acid sulphate esters as novel vaccine adjuvants. Effect of chemical composition. *Vaccine* 2004; 23:743–54; Hilgers et al., Sucrose fatty acid sulphate esters as novel vaccine adjuvant. *Vaccine* 24S2 (2006) S2/81–S2/82). Lyophilization of nano-emulsions has been conducted previously, however lyophilization of a vaccine nano-emulsion adjuvant, maintaining immunogenicity after lyophilization, has not been demonstrated. Similarly, co-lyophilization of a nano-emulsion mixture with one or more separate proteins has also not been demonstrated.

SUMMARY

The present disclosure provides for a stable immunogenic composition capable of eliciting a robust and durable immune response, comprising at least one antigen further comprising a viral glycoprotein and at least one nano-emulsion adjuvant which are co-lyophilized and can be reconstituted immediately prior to use. In an alternative example, the present disclosure provides for a vaccine composition comprising at least two antigens, wherein each antigen is specific to a different genus of filovirus and which also comprises at least one nano-emulsion adjuvant. Preferably, the viral glycoprotein is at least one selected from the group of viruses consisting of MARV, SUDV and EBOV. Optionally, the viral glycoprotein is a filovirus glycoprotein.

In another example, the present disclosure provides for a stable, immunogenic composition capable of eliciting a robust and durable immune response, comprising at least one antigen, wherein the at least one antigen comprises a viral glycoprotein, and at least one adjuvant. In one aspect, the present disclosure provides for a stable, immunogenic composition capable of eliciting a robust and durable immune response, comprising at least one antigen, wherein the at least one antigen comprises a filovirus glycoprotein, and at least one adjuvant, wherein the at least one adjuvant comprises sucrose fatty acid sulphate esters, and wherein the at least one adjuvant is a nano-emulsion adjuvant that is mixed with the antigen prior to lyophilization. Optionally, the composition does not include alum.

Alternatively, the composition of the present disclosure comprises two or more antigens, wherein each antigen is specific to a different virus.

In yet another example, the composition of the present disclosure further comprises a nano-emulsion adjuvant, wherein the nano-emulsion, preferably, is CoVaccine-HT. In a preferred example, the nano-emulsion adjuvant is mixed with the antigen prior to lyophilization. Preferably, the nano-emulsion adjuvant that is mixed is CoVaccine-HT.

Another example of the disclosure provides for a method of manufacturing a stable immunogenic composition capable of eliciting a robust and durable immune response to more than one virus, comprising at least two antigens, wherein each antigen is specific to a different virus from the same or different families and providing at least one adjuvant, wherein the adjuvant does not contain alum. In another aspect, the present disclosure provides for a method of manufacturing a stable immunogenic composition capable of eliciting a robust and durable immune response to more than one virus, comprising at least two antigens, wherein each antigen is specific to a different virus from the same or different families, wherein at least one antigen comprises a filovirus glycoprotein, and providing at least one adjuvant, wherein the at least one adjuvant comprises sucrose fatty acid sulphate esters, wherein the at least one adjuvant is a nano-emulsion that is combined with the antigen prior to lyophilization and wherein the at least one adjuvant does not contain alum. Preferably, the adjuvant is a nano-emulsion and, most preferably, the adjuvant is CoVaccine-HT. Alternatively, the adjuvant is combined with the antigen(s) prior to lyophilization. Preferably, the adjuvant to be combined is CoVaccine-HT.

In another example, the present disclosure provides for a method of eliciting an immune response in a mammal comprising: (a) providing a stable, immunogenic composition capable of eliciting a robust and durable immune response, comprising at least one antigen, wherein the at least one antigen comprises a viral glycoprotein, and at least one adjuvant; (b) reconstituting the composition of (a) prior to use with a pharmaceutically acceptable diluent; and (c) administering the composition to the mammal in need thereof. In another aspect, the present disclosure provides use of the composition disclosed herein in the manufacture of a medicament for eliciting an immune response in a mammal, the use comprising: (a) providing the composition disclosed herein; and (b) reconstituting the composition of (a) prior to use with a pharmaceutically acceptable diluent; wherein the composition is to be administered to the mammal in need thereof. Preferably, the composition is administered up to three separate occasions, resulting in the mammal being protected from subsequent infections by the virus associated with the viral glycoprotein present in the composition.

In yet another example of the present disclosure provides for a stable immunogenic composition capable of eliciting a robust and durable immune response, comprising at least one nano-emulsion adjuvant, wherein the at least one nano-emulsion adjuvant is lyophilized and can be reconstituted immediately prior to use with an antigen.

What is claimed is:

1. A stable, immunogenic composition capable of eliciting a robust and durable immune response, comprising at least one antigen, wherein the at least one antigen comprises a filovirus glycoprotein, and at least one adjuvant, wherein the at least one adjuvant comprises sucrose fatty acid sulphate esters, and wherein the at least one adjuvant is a nano-emulsion adjuvant that is mixed with the antigen prior to lyophilization.

2. The composition of claim 1, wherein the composition does not include alum.

3. The composition of claim 1, wherein the composition comprises two or more antigens, wherein each antigen is specific to a different virus.

4. A method of manufacturing a stable immunogenic composition capable of eliciting a robust and durable immune response to more than one virus, comprising at least two antigens, wherein each antigen is specific to a different virus from the same or different families, wherein at least one antigen comprises a filovirus glycoprotein, and providing at least one adjuvant, wherein the at least one adjuvant comprises sucrose fatty acid sulphate esters, wherein the at least one adjuvant is a nano-emulsion that is combined with the antigen prior to lyophilization and wherein the at least one adjuvant does not contain alum.

5. Use of the composition of claim 1 in the manufacture of a medicament for eliciting an immune response in a mammal, the use comprising:

(a) providing the composition of claim 1; and

(b) reconstituting the composition of (a) prior to use with a pharmaceutically acceptable diluent; wherein the composition is to be administered to the mammal in need thereof.

6. The use of claim 5, wherein the composition is to be administered up to three separate occasions, resulting in the mammal being protected from subsequent infections by the virus associated with the filovirus glycoprotein present in the composition.