current *Eimeria*-based vaccines produces substantial vaccine-reaction morbidity and economic losses in vaccinated flocks. Thus an effective low-virulence vaccine against *Eimeria* is needed. An effective vaccine for *Eimeria* based on conserved immunogenic targets may also prove useful as a vaccine against other apicomplexan parasites.

SUMMARY

A vaccine vector comprising a first polynucleotide sequence encoding an Apicomplexan Rhomboid polypeptide and methods of using the same are provided herein.

In one aspect, there is provided a vaccine vector comprising a first polynucleotide sequence encoding an Apicomplexan Rhomboid polypeptide optionally expressed on the surface of the vaccine vector, wherein the Rhomboid polypeptide consists of a polypeptide having greater than 90% sequence identity to a polypeptide selected from the group consisting of SEQ ID NO: 1, SEQ ID NO: 2, SEQ ID NO: 3, SEQ ID NO: 4, SEQ ID NO: 37, SEQ ID NO: 38, an immunogenic fragment of SEQ ID NO: 1, an immunogenic fragment of SEQ ID NO: 2, an immunogenic fragment of SEQ ID NO: 3, an immunogenic fragment of SEQ ID NO: 4, an immunogenic fragment of SEQ ID NO: 37, an immunogenic fragment of SEQ ID NO: 38 and combinations thereof.

In one aspect, there is provided a pharmaceutical composition comprising the vaccine vector of as disclosed herein and a pharmaceutically acceptable carrier.

In one aspect, there is provided a use of the vaccine vector as disclosed herein or the pharmaceutical composition as disclosed herein in the manufacture of a medicament for enhancing the immune response of a subject against an Apicomplexan parasite.

In one aspect, there is provided a use of the vaccine vector of as disclosed herein or the pharmaceutical composition as disclosed herein in the manufacture of a medicament for reducing morbidity associated with infection with an Apicomplexan parasite in a subject as compared to a control subject not administered the vaccine vector.

In one aspect, there is provided a vaccine vector comprising a first polynucleotide sequence encoding an Apicomplexan Rhomboid polypeptide expressed on the surface of the vaccine vector, wherein the Rhomboid polypeptide consists of a polypeptide having greater than 90% sequence identity to a polypeptide selected from the group consisting of SEQ ID NO: 1, SEQ ID NO: 2, SEQ ID NO: 3, SEQ ID NO: 4, SEQ ID NO: 37, SEQ ID NO: 38, an immunogenic fragment of SEQ ID NO: 1, an immunogenic fragment of SEQ ID NO: 2, an immunogenic fragment of SEQ ID NO: 3, an immunogenic fragment of SEQ ID NO: 4, an immunogenic fragment of SEQ ID NO: 37, an immunogenic fragment of SEQ ID NO: 38 and combinations thereof.

In one embodiment, a vaccine vector comprising a first polynucleotide encoding an Apicomlexan Rhomboid polypeptide or an immunogenic fragment thereof and a second polypeptide sequence encoding an immunostimulatory polypeptide is disclosed. The Apicomplexan Rhomboid polypeptide and the immunostimulatory polypeptide are suitably expressed on the surface of the vaccine vector. The Apicomplexan Rhomboid polypeptide may comprise SEQ ID NO: 1, SEQ ID NO: 2, SEQ ID NO: 3, SEQ ID NO: 4, SEQ ID NO: 37, SEQ ID NO: 38, an immunogenic fragment of at least one of SEQ ID NO: 1-4, 37-38 or

CLAIMS

We claim:

1. A vaccine vector comprising a first polynucleotide sequence encoding an Apicomplexan Rhomboid polypeptide ~~optionally~~ expressed on the surface of the vaccine vector, wherein the Rhomboid polypeptide consists of a polypeptide having greater than 90% sequence identity to a polypeptide selected from the group consisting of SEQ ID NO: 1, SEQ ID NO: 2, SEQ ID NO: 3, SEQ ID NO: 4, SEQ ID NO: 37, SEQ ID NO: 38, an immunogenic fragment of SEQ ID NO: 1, an immunogenic fragment of SEQ ID NO: 2, an immunogenic fragment of SEQ ID NO: 3, an immunogenic fragment of SEQ ID NO: 4, an immunogenic fragment of SEQ ID NO: 37, an immunogenic fragment of SEQ ID NO: 38 and combinations thereof.

2. The vaccine vector of claim 1 further comprising a second polynucleotide sequence encoding an immunostimulatory polypeptide, wherein the immunostimulatory polypeptide is expressed on the surface of the vaccine vector.

3. The vaccine vector of claim 2, wherein the immunostimulatory polypeptide comprises an HMGB1 polypeptide.

4. The vaccine vector of claim 3, wherein the HMGB1 polypeptide comprises a polypeptide selected from the group consisting of SEQ ID NOs: 15-23, a fragment of at least one of SEQ ID NOs: 15-23, a polypeptide having at least 95% sequence identity to SEQ ID NOs: 15-23 and combinations thereof.

5. The vaccine vector of any one of claims 2-4, wherein the immunostimulatory polypeptide comprises a CD154 polypeptide capable of binding CD40, the CD154 polypeptide having fewer than 50 amino acids and comprising amino acids 140-149 of a polypeptide selected from the group consisting of SEQ ID NO: 24, SEQ ID NO: 25 and a homolog thereof, or is a polypeptide selected from the group consisting of SEQ ID NO: 26, SEQ ID NO: 27, SEQ ID NO: 28, SEQ ID NO: 29, SEQ ID NO: 30 and polypeptides having at least 90% sequence identity to at least one of SEQ ID NOs: 26-30.

~~17. A use of the vaccine vector of any one of claims 1-13 or the pharmaceutical composition of claim 14 in the manufacture of a medicament for reducing morbidity associated with infection with an Apicomplexan parasite in a subject as compared to a control subject not administered the vaccine vector.~~

178. The use of any one of claims 15-167, wherein the vaccine vector is administered by a route selected from the group consisting of oral, mucosal, parenteral, sub-cutaneous, intramuscular, intraocular and *in ovo*.

189. The use of any one of claims 15-178, wherein the subject is a poultry species or a mammal.

1920. The use of claim 189, wherein the subject is selected from the group consisting of a human, swine, chicken, turkey and cow.

201. The use of any one of claims 15-1920, wherein about 10^4 to about 10^9 vector copies of the vaccine are administered to the subject.

212. The use of any one of claims 15-201, wherein the vaccine vector is killed prior to administration to the subject or is not capable of replicating in the subject.

223. The use of any one of claims 15-212, wherein the Apicomplexan parasite is selected from the group consisting of *Eimeria, Plasmodium, Toxoplasma*, *Neospora* and *Cryptosporidium*.