[045] The examples below demonstrate the ability to select and remove sequences from the MSP-1 p33 region and link the selected sequences to the MSP-1 p19 core region so as to produce novel recombinant subunit proteins that have enhanced immunogenic potential as vaccine candidates. The expression and secretion of the novel MSP-1 C-terminal subunit proteins is also demonstrated utilizing stably transformed insect cells. The purification of the expressed subunit proteins is also demonstrated. Examples are provided that demonstrate the enhanced immunogenic properties of the novel MSP-1 C-terminal subunit proteins. The results presented below demonstrate that the selection and demonstration of enhanced immunogenic potential results in highly variable results that can vary from a loss of a specific immune response to highly focused immune responses. Thus, the selection of enhancing sequences from the p33 region in an effort to focus the immune response the p19 core region is not entirely predictable and must be determined empirically. Several of the MSP-1 C-terminal subunit proteins unexpectantly were able to elicit enhanced significant immunogenic properties, parasite inhibition activity greater than 50%, despite the fact that the novel recombinant proteins produced moderate general antibody responses. Hence, the invention described herein is unique in the composition of the recombinant subunit proteins described and in their resultant immunogenic properties.

[046] The following examples are intended to illustrate ~~but not to limit~~ the invention.

EXAMPLE 1

Assessment of T-cell epitopes in the p33 region of MSP-1 p42

[047] There are many studies that have utilized either the p19 or p42 subunits of MSP-1 in an effort to develop a malaria vaccine. There have been reports of success for each of these MSP-1 subunits as well as failures with each of these subunits, as reviewed above and further discussed below. Because of the conflicting results, it is not clear which regions of these subunits are most relevant in regards to their ability to serve as antigens in eliciting antibody responses that are capable of inhibiting parasite growth *in vitro* or in the protection of animals to challenge. It has been hypothesized that the induction of growth-inhibitory antibodies to the p19 core region is determined by the specificity of T helper epitopes in p33 region. In support of this theory, a study that directly compared the ability of recombinant p19 and p42 subunits to elicit parasite growth inhibitory antibodies was conducted (Hui et al, 1994). Using the same adjuvant (FCA), both p19 and p42 recombinants elicited high titers of antibodies based on ELISA

CLAIMS

What is claimed is:

1. MSP-1 C-terminal recombinant subunit proteins with enhanced immunogenic properties comprising:
the p19 core region of the *Plasmodium falciparum* MSP-1 protein of the C-terminal region ~~operably linked to at least one~~ which a segment of the p33 region is operably linked, wherein~~.~~

~~2. The recombinant subunit proteins of claim 1 wherein~~ said ~~at least one~~ segment of the p33 region does not include the amino acid sequence LVQNFPNTIISKLIEGK and~~.~~

~~3. The recombinant subunit proteins of claims 1 or 2, wherein the enhanced immunogenic properties are measured as increased and consistent parasite growth inhibition activity.~~

~~4.~~ ~~The recombinant subunit proteins of claim 1 or 2~~, wherein all animals immunized with said protein have an immunologic response that results in parasite growth inhibition activity greater than 50%.

~~5. The recombinant subunit proteins according to any one of claims 1, 3 and 4, wherein the segments of the p33 region are derived by deletions of the N-terminus of the p33 region shown in SEQ. ID. NO: 1, SEQ. ID. NO: 2, SEQ. ID. NO: 5, SEQ. ID. NO:7 and SEQ. ID. NO: 17.~~

~~6~~2. The recombinant subunit proteins according to ~~any one of~~ claims 1~~ to 4~~, wherein the linked segments of the p33 region ~~are derived by linkage of selected p33 region segments shown in~~ is selected from the group consisting of SEQ. ID. NO: 8, ~~SEQ. ID. NO: 11,~~ SEQ. ID. NO: 14, SEQ ID NO: 16 and SEQ. ID. NO: 18.

~~7~~3. The recombinant subunit proteins of ~~any one of~~ claims 1~~-6~~ or 2, wherein the protein is expressed in a eukaryotic cell culture system.

~~8~~4. The recombinant subunit proteins of claim ~~6~~3, wherein the cell culture expression system utilizes insect cells.

95. The recombinant subunit proteins of claim ~~74~~, wherein the insect cells are *Drosophila* S2 cells.

~~106~~. Vaccine formulations comprising MSP-1 C-terminal subunit proteins of any of claims 1-59.

~~117~~. Use of vaccine formulations comprising MSP-1 C-terminal subunit proteins of any of claims 1-95 in the manufacture of a medicament for eliciting protection from malaria infection.

~~128~~. The vaccine formulations of ~~Claim~~ claim ~~10~~ 6 or use of claim ~~11~~7, wherein the segment of the p33 region segment of the MSP-1 C-terminal subunit protein is ~~at least one protein shown in~~ selected from the group consisting of ~~SEQ. ID. NO: 1, SEQ. ID. NO: 2, SEQ. ID. NO: 5, SEQ. ID. NO:7~~ SEQ. ID. NO: 8, ~~SEQ. ID. NO: 11~~, SEQ. ID. NO: 14, SEQ. ID. NO:~~17~~ 16 and SEQ. ID. NO: 18.