CLAIMS

1. Antigenic multivalent molecular construct consisting of basic units comprising the helper-T dependent carrier detoxified proteins selected between Enterotoxoid A and Cytotoxoid B from *Clostridium difficile* covalently bound to a minimum of three carbohydrate structures from enteropathogenic bacteria selected between bacterial polysaccharides or detoxified lipopolysaccharides of different serological specificity, wherein each carbohydrate structure comprises at least one of the repeating basic epitopes consisting of a minimum of five to twelve monosaccharide residues, wherein at least one mole of carrier protein is bound to at least one mole of each of the at least three carbohydrate structure or their molar sum.

2. Antigenic multivalent molecular construct according to claim 1, wherein said Enterotoxoid A or Cytotoxoid B originating from *Clostridium difficile* are detoxified by formalin-treatment or by DNA recombinant technology.

3. Antigenic multivalent molecular construct according to anyone of the preceding claims 1-2, wherein said carried carbohydrate structures of different serological specificity are selected among capsular polysaccharides of *Salmonella typhi*, *Vibrio cholerae*, *Escherichia coli* and *Clostridium difficile* or a combination thereof.

4. Antigenic multivalent molecular construct according to anyone of the preceding claims 1-2, wherein said detoxified lipopolysaccharide is an Endotoxoid.

5. Antigenic multivalent molecular construct according to claim 1 or 4, wherein said carried carbohydrate structures of different serological specificity are selected among detoxified lipopolysaccharides/ Endotoxoids of enteropathogenic bacteria selected among *Salmonella typhi*, *Escherichia coli*, *Vibrio cholerae*, *Salmonella enteritidis*, *Shigella flexneri, Salmonella paratyphi A, Salmonella dysenteriae*, *Shigella sonnei* and *Salmonella cholerasuis* or a combination thereof.

6. Antigenic multivalent molecular construct according to anyone of the claims 1-5, selected between:

- Enterotoxoid A covalently bound to the capsular polysaccharides of *Salmonella typhi*, *Vibrio cholerae* and *Escherichia coli*;
- Cytotoxoid B covalently bound to the capsular polysaccharides of *Salmonella typhi*, *Vibrio cholerae* and *Escherichia coli*;

- Enterotoxoid A covalently bound to the detoxified lipopolysaccharides/Endotoxoids of *Salmonella enteritidis*, *Salmonella paratyphi* A and *Salmonella dysenteriae*;
- Cytotoxoid B covalently bound to the detoxified lipopolysaccharides/Endotoxoids of *Salmonella enteritidis*, *Salmonella paratyphi* A and *Salmonella dysenteriae*.

7. Antigenic multivalent molecular construct according to anyone of the preceding claims, for use in a vaccine for the protection of a subject from the infections due to at least one of the enteropathogenic bacteria selected from *Clostridium difficile, Salmonella typhi, Escherichia coli, Vibrio cholerae, Salmonella enteritidis, Shigella flexneri, Shigella sonnei, Salmonella paratyphi A, Salmonella dysenteriae, Salmonella cholerasuis* or a combination thereof.

8. A vaccine formulation comprising at least one antigenic multivalent molecular construct as defined according to anyone of claims 1-6 in a physiologically acceptable vehicle, optionally together with an adjuvant or excipients pharmaceutically acceptable.

9. A vaccine formulation according to claim 8, wherein the dose of each carrier antigen and/or carried antigens ranges between 0.1 to 100 μg, preferably being from 1 to 10 μg.

10. A vaccine formulation according to anyone of the claim 8-9, wherein said adjuvant is chosen between a mineral adjuvant selected from aluminium phosphate, aluminium hydroxide; an organic adjuvant selected from squalene-based adjuvants such as MF59, QF 21, Addavax and a biological adjuvant selected from monophosphoryl-lipid A and trehalose dicorynomycolate.

11. A vaccine formulation according to anyone of the claims 8-10, wherein the amount of adjuvant ranges between 0.1-1 mg/dose, preferably being 0.5 mg/dose.

12. A vaccine formulation according to anyone of the claim 8-11, said formulation being suitable for the administration by subcutaneous, intramuscular, intracutaneous or transcutaneous route.

13. A polyvalent vaccine formulation according to anyone of the preceding claims 8-12, for use in medical human or veterinary field for the protection of a subject from the systemic and enteric infections due to at least one of the enteropathogenic bacteria selected among *Clostridium difficile, Salmonella typhi*, *Escherichia coli, Vibrio cholerae, Salmonella enteritidis, Shigella flexneri, Shigella sonnei, Salmonella paratyphi A, Salmonella dysenteriae, Salmonella cholerasuis, Klebsiella, Enterobacter* or a combination thereof.

14. A polyvalent vaccine formulation for use in medical human or veterinary field according to claim 13, wherein said subject belongs to the human population.

15. A polyvalent vaccine formulation for use in medical field according to claim 14, for use in the prevention and/or treatment of viral gastrointestinal infections due to human noroviruses.

16. A conjugation process for preparing the antigenic multivalent molecular construct according to anyone of claims 1-6, which comprises the following steps:

a) chemical activation of the at least three antigenically different carbohydrate structures selected between :

- capsular polysaccharides of *Salmonella typhi, Vibrio cholerae, Escherichia coli* and *Clostridium difficile*

or

- lipopolysaccharides from *Salmonella typhi*, *Escherichia coli, Vibrio cholerae*, *Salmonella enteritidis*, *Shigella flexneri*, *Shigella sonnei, Salmonella paratyphi A*, *Salmonella dysenteriae* and *Salmonella cholerasuis*;

to polyfunctionality by O-de-hydrogen uncoupling via oxidation and reductive amination forming imine reduced bonds with an alkyl diamine spacer, then derivatized to active esters;

b) simultaneous coupling of the at least three ester-derivative carbohydrate structures to the amino groups of the polyfunctional carrier protein Enterotoxoid A or Cytotoxoid B from *Clostridium difficile,* through the formation of amide bonds;

wherein at least one mole of protein carrier is reacted with at least one mole of each, or their molar sum, of said antigenically different carbohydrate structures.

17. A conjugation process according to claim 16, wherein the carbohydrate structures are chemically activated in their corresponding diamine butyric acid derivatives and the active esters are succinimidyl esters.

18. A conjugation process for preparing the antigenic multivalent molecular construct according to anyone of claims 1-6, which comprises the simultaneous coupling of the amino groups of the polyfunctional carrier protein Enterotoxoid A or Cytotoxoid B from *Clostridium difficile* with at least three antigenically different carbohydrate structures selected between:

- capsular polysaccharides of *Salmonella typhi, Vibrio cholera*, *Escherichia coli* and *Clostridium difficile* or

- lipopolysaccharides from *Salmonella typhi*, *Escherichia coli, Vibrio cholerae*, *Salmonella enteritidis*, *Shigella flexneri*, *Shigella sonnei, Salmonella paratyphi A*, *Salmonella dysenteriae* and *Salmonella cholerasuis*;

via reductive amination forming imine-reduced bond(s), such carbohydrate structures being previously activated to polyfunctionality, with or without molecular spacers, by O-de-hydrogen uncoupling in vicinal hydroxyl groups, via oxidation.

19. A conjugation process according to anyone of the claims 16-18, further comprising an additional step of detoxification of said lipopolysaccharides alternatively by a) cleaving out the Lipid A moiety before or after the coupling reaction is performed, or b) saturation of the Lipid A-binding site through a specific strategy that use the Synthetic Anti-Endotoxin Peptides (SAEP), before or after the coupling reaction is performed;

wherein at least one mole of protein carrier is reacted with at least one mole of each, or their molar sum, of said antigenically different carbohydrate structures.

20. A conjugation process according to anyone of the claims 16-19, wherein the carbohydrate structures of step a) comprise at least one of the repeating basic epitopes consisting of a minimum of five to twelve monosaccharide residues as assessed by molecular mass determination and NMR spectroscopy, said repeating basic epitopes being antigenically assessed by reactivity with type-specific or group-specific polyclonal or monoclonal antibodies through the determination of their respective MIC50 values in the inhibition of their homologous Polysaccharide-Antibody reference system.