

CLAIMS

1. A nano-carrier system, comprising a functional RNA encapsulated inside an Enterobacteria phage MS2 (MS2) virus-like particle (VLP), wherein the functional RNA comprises an RNA riboswitch and a packing sequence, and said riboswitch maintains its functionality while being encapsulated inside said VLP and is protected from nuclease degradation *in vivo*.
2. The system of claim 1, wherein said riboswitch is selected from the group consisting of: a purine riboswitch, a cobalamin riboswitch, a fluoride riboswitch, a glutamine riboswitch, a glycine riboswitch and a xanthine riboswitch.
3. The system of claim 2, wherein said riboswitch is a naturally-occurring or synthetic adenine riboswitch, and/or wherein said packing sequence is an MS2 translational repression RNA (TR-RNA).
4. The system of any one of claims 1-3, wherein the riboswitch is located 5' to the TR-RNA, and said riboswitch and TR-RNA are separated by a non-coding RNA spacer characterized by a length of 100-200 nucleotides (nt) and a guanine-cytosine content (GC content) of 20%-70%, and wherein said riboswitch is located less than 30 nt from the 5' end, said TR-RNA is located at the 3' end, and the spacer is 120-170 nt in length and has a GC content of 40%-65%.
5. The system of claim 3, wherein said riboswitch is the *pbuE* A58U adenine riboswitch (SEQ ID NO: 1), or wherein said functional RNA has a nucleic acid sequence selected from the group consisting of SEQ ID NOs: 6, 7, 9-13, 19-21 and 23.
6. The system of any one of claims 1-5, wherein said VLP comprises a capsid comprising wild-type (WT) MS2 coat proteins (CP).
7. The system of claim 6, wherein said WT MS2 CP is in the form of a single-chain CP dimer optionally comprising a linker between the CP monomer units, and said VLP is devoid of exogenously added targeting motifs.
8. The nano-carrier system of claim 1, comprising an adenine riboswitch encapsulated inside an Enterobacteria phage MS2 virus-like particle (VLP).
9. A nucleic acid construct encoding the nano-carrier system of any one of claims 1-8.
10. A pharmaceutical composition comprising the nano-carrier system of claim 1 and a pharmaceutically acceptable carrier, excipient or diluent.
11. Use of a pharmaceutical composition comprising a nano-carrier system, the system comprising:

a virus-like particle (VLP), and a metabolite-specific functional RNA encapsulated inside the VLP, wherein the functional RNA maintains its ability to selectively bind the metabolite while being encapsulated inside said VLP, and is protected from nuclease degradation *in vivo*, in the preparation of a medicament for treating a metabolic disorder characterized by elevated metabolite levels in a subject, or for inhibiting or delaying the formation of metabolite assemblies in said subject.

12. The use of claim 11, wherein said functional RNA comprises a riboswitch and a packing sequence, and/or wherein said VLP is an Enterobacteria phage MS2 (MS2) VLP.

13. The use of claim 11, for treating a metabolic disorder characterized by elevated metabolite levels wherein said disorder is selected from the group consisting of adenine phosphoribosyl transferase deficiency (APRT), adenosine deaminase deficiency (ADA deficiency), tyrosinemia and phenylketonuria, or wherein said subject is afflicted with hyperuricemia, Lesch-Nyhan syndrome and/or gout.

14. The use of claim 11, for inhibiting or delaying the formation of metabolite assemblies wherein the metabolite is selected from the group consisting of adenine, tyrosine and phenylalanine, or wherein said subject is afflicted with, or is at risk for developing, kidney stones, gallstones, and/or cholesterol deposits.

15. A method of reducing the levels of a metabolite in a food product, comprising contacting the product or a precursor thereof with a chelating composition comprising a nano-carrier system, the system comprising:

a virus-like particle (VLP), and a metabolite-specific functional RNA encapsulated inside the VLP, wherein the functional RNA maintains its ability to selectively bind the metabolite while being encapsulated inside said VLP, and is protected from nuclease degradation *in vivo*.

16. The method of claim 15, wherein said metabolite is selected from the group consisting of lactic acid, ammonia and ionic forms thereof.

17. The method of claim 15 wherein said food product is a cultured meat product.

18. The method of claim 17, wherein said product is selected from the group consisting of patties, sausages, burgers, meatballs, cutlets, and hotdogs.

19. The method of claim 15, wherein said VLP is an Enterobacteria phage MS2 (MS2) VLP.

20. A nano-carrier system comprising:
a virus-like particle (VLP), and a functional RNA encapsulated inside said VLP,

wherein said VLP is configured to protect said functional RNA from nuclease degradation *in vivo*, and wherein said functional RNA maintains its functionality while being encapsulated inside said VLP.

21. Use of a treatment composition in the preparation of a medicament for treating a metabolic disorder in a subject, wherein the treatment composition comprises a nano-carrier system comprising:

a virus-like particle (VLP), and a functional RNA encapsulated inside said VLP,
wherein said VLP is configured to protect said functional RNA from nuclease degradation *in vivo*,
and wherein said functional RNA maintains its functionality while being encapsulated inside said VLP.