selective for only the TCN and doesn't significantly affect the many other sensory nerves that provide normal tactile sensations and "cutaneous awareness." Since lidocaine and other topical local anesthetics lack this specificity for TCN, they can cause numbness and loss of function.

[0005] While topically applied strontium can rapidly inhibit the activation of TCN sensory nerve subsets that transmit sensations of pain (*e.g.*, burning and stinging) and pruritus (itching), recent investigations to understand strontium's anti-irritant mechanisms surprisingly reveal that strontium also has negative effects on several biochemical pathways that tend to negate the positive anti-irritant benefits of strontium for treatment of neuropathic conditions.

[0006] Therefore it is desirable to create new strontium-containing molecules, complexes and formulations that increase the "positive" therapeutic benefits of strontium and decrease the "negative" effects of strontium on acute pain, pruritis and neuropathic conditions

SUMMARY

[0007] In accordance with the teachings herein, the present disclosure relates generally to compositions of strontium-containing complexes in a suitable carrier vehicle.

In a first aspect, there is provided a composition comprising a complex of: divalent cationic strontium; at least one cysteine-based anti-oxidant selected from the group consisting of: cystine, N-acetyl cysteine (NAC), N-acetyl cysteinate, N-acetyl cystine, and N,S-diacetylcysteine~~, and esters thereof~~; and at least one polyhydroxyphenol selected from the group consisting of: gallic acid, caffeic acid, and sugar moiety esters thereof; in a suitable carrier vehicle.

CLAIMS

1. A composition comprising a complex of:

divalent cationic strontium;

at least one cysteine-based anti-oxidant selected from the group consisting of: cystine, N-acetyl cysteine (NAC), N-acetyl cysteinate, N-acetyl cystine, and N,S-diacetylcysteine ~~and esters thereof~~; and

at least one polyhydroxyphenol selected from the group consisting of: gallic acid, caffeic acid, and sugar moiety esters thereof;

in a suitable carrier vehicle.

2. The composition of Claim 1, wherein the at least one cysteine-based anti-oxidant is N-acetyl cysteine (NAC) ~~and esters thereof~~.

3. The composition according to Claim 1 or 2, wherein the at least one polyhydroxyphenol is gallic acid or sugar moiety esters thereof.

4. The composition of claim according to Claim 1 or 2, wherein the at least one polyhydroxyphenol is caffeic acid or sugar moiety esters thereof.

5. The composition according to claim 1 or 2, wherein the at least one polyhydroxyphenol is a mixture of gallic acid and caffeic acid, or sugar moiety esters thereof.

6. The composition according to any one of Claims 1 to 5, wherein the at least one polyhydroxyphenol is added to the composition as a plant extract.

7. The composition according to claim 6, wherein the plant extract is a green tea extract or a soy extract.

8. The composition according to any one of claims Claim 1 to 7, wherein the at least one cysteine-based anti-oxidant and the at least one polyhydroxyphenol are conjugated together by a cleavable bond.

9. The composition according to Claim 8, wherein the cleavable bond is selected from the group consisting of: a peptide bond, an ester bond, a thioester bond, an enzymatically cleavable bond, a disulphide bond, and a pH dependent bond.

10. The composition according to claim 9, wherein the cleavable bond is a thioester bond.

11. The composition according to any one of Claims 1 to 10, further comprising a polymer.

12. The composition according to Claim 11, wherein the polymer is a polyanionic polymer.

13. The composition according to Claim 11, wherein the polymer is selected from the group consisting of: polyvinylpyrrolidone (PVP), cyclodextrins, carrageenan, alginic acid, xanthan gum, sulfated polysaccharides, pentosan polysulfate, chondroitin sulfate, dextran sulfate and heparin sulfate.

14. The composition according to any one of Claims 1 to 13, further comprising a pH below physiological levels.

~~15. The composition according to Claim 14, wherein the pH is above 0.6.~~

~~16~~15. The composition according to any one of Claims 1 to ~~15~~14, further comprising an osmolarity of at least 400 milliosmoles.

~~17~~16. The composition of any one of Claims 1 to ~~16~~15, wherein the composition is formulated for topical application.

~~18~~17. Use of the composition of any one of Claims 1 to ~~17~~16 in the manufacture of a medicament for treating pain, pruritus, or inflammation in a subject in need thereof.

~~19~~18. The use of Claim ~~18~~17, wherein the medicament is to be topically administered.

~~20~~19. The use of Claim ~~19~~18, wherein the medicament is to be topically administered to keratinized skin or mucous membranes in the eye, mouth, throat, esophagus, gastrointestinal tract, respiratory tract or genitourinary tract.

~~21~~20. The use according to Claim ~~18~~17, wherein the pain, pruritus, or inflammation is acute.

~~22~~21. The use according to Claim ~~21~~20, wherein the acute pain, pruritus, or inflammation is due to allergies, insect bites, exposure to venom, poison ivy, atopic dermatitis, psoriasis, thermal burns, ionizing radiation, exposure to chemicals, trauma, surgery, nerve compression, oral or throat ulcers, bacteria infections, or viral infections.

~~23~~22. The use according to Claim ~~18~~17, wherein the pain, pruritus, or inflammation is chronic.

~~24~~23. The use of Claim ~~23~~22, wherein the chronic pain, pruritus, or inflammation is due to atopic dermatitis, psoriasis, viral infections, nerve compression, back pain, amputation, or trauma.

~~25~~24. The use according to Claim ~~18~~17, wherein the pain, pruritus, or inflammation is neuropathic.

~~26~~25. The use of Claim ~~25~~24, wherein the neuropathic pain, pruritus, or inflammation is due to post herpetic neuralgia, back pain, nerve compression, viral infections, multiple sclerosis, Parkinson's disease, diabetes, trauma, amputation, or drug use.

~~27~~26. Use of a topical composition comprising the composition of any Claims 1-~~17~~16 in the manufacture of a medicament for treating atopic dermatitis in a patient in need thereof.

~~28~~27. Use of a topical composition comprising the composition of any Claims 1-~~17~~16 in the manufacture of a medicament for treating psoriasis in a patient in need thereof.

~~29~~28. Use of a topical composition comprising the composition of any Claims 1-~~17~~16 in the manufacture of a medicament for treating post herpetic neuralgia in a patient in need thereof.

~~30~~29. Use of a topical composition comprising the composition of any Claims 1-~~17~~16 in the manufacture of a medicament for treating diabetic neuralgia in a patient in need thereof.

~~31~~30. Use of a topical composition comprising the composition of any Claims 1-~~17~~16 in the manufacture of a medicament for treating radiation dermatitis in a patient in need thereof.