skin from repeated exposure to antimicrobial agents contained in the articles, or to at least reduce or minimise the potential damage caused by antimicrobial agents to the skin.

SUMMARY

The applicant has developed new elastomeric articles that contain an antimicrobial agent while also providing protection to the user's skin from exposure to the antimicrobial agent. The applicant has found that by including an antimicrobial agent on an external surface of the article, and a skin-protective agent selected from a probiotic, prebiotic or a combination thereof on an internal surface of the article, it is possible to obtain the benefits of each type of agent without adverse interactions. The applicant was surprised to find that it is possible to obtain elastomeric articles with both antimicrobial and skin protective properties without a prohibitive negative impact on the glove properties, such as elasticity, modulus (fatigue associated with resistance of the glove), softness, film barrier properties, and/or film thickness.

According to the present disclosure, there is provided an elastomeric article comprising:

- an elastomeric film comprising one or more film layers, and including an external surface and an internal surface,
- an antimicrobial agent on the external surface of the elastomeric film, and
- a skin-protective agent selected from a probiotic, a prebiotic, or a combination thereof on the internal surface of the elastomeric film.

In particular, the present disclosure provides an elastomeric article comprising:

- an elastomeric film comprising one or more film layers, and including an external surface and an internal surface,
- an antimicrobial agent that is effective against both beneficial and harmful microorganisms on the external surface of the elastomeric film, and
- a skin-protective agent selected from a probiotic, a prebiotic, or a combination thereof on the internal surface of the elastomeric film,

wherein the inner surface of the film is free of an antimicrobially-effective amount of an antimicrobial agent that is effective against both beneficial and harmful microorganisms.

In addition, there is provided a method for the manufacture of an elastomeric article, the method comprising:

- providing an elastomeric film comprising one or more film layers, the elastomeric film including first and second opposing surfaces;
- introducing an antimicrobial agent onto or into the first opposing surface; and
- introducing a skin-protective agent selected from a probiotic, a prebiotic, or a combination thereof onto or into the second opposing surface.

To ensure that the antimicrobial agent does not appear in any appreciable amount on the inner surface of the film (i.e. to ensure that the inner surface is free of an antimicrobially effective amount of antimicrobial agent that is effective against both beneficial and harmful microorganisms), the step of introducing an antimicrobial agent onto or into the first opposing surface should be performed in a manner so as to avoid the antimicrobial agent from being introduced onto the second opposing surface. Examples of techniques for ensuring this occurs are described in the detailed description.

In preferred examples, the applicant found that unexpected benefits come from including a layer that is free of both the antimicrobial agent and the skin-protective agent between the external and internal surfaces that contain those agents. This layer functions as a barrier layer, and aids in preserving the efficacy of the skin-protective agent.

Therefore, according to a one aspect, there is provided an elastomeric article comprising:

- an elastomeric film comprising one or more film layers, and including an external surface and an internal surface,
- an antimicrobial agent that is effective against both beneficial and harmful microorganisms on the external surface of the elastomeric film,
- a skin-protective agent selected from a probiotic, a prebiotic, or a combination thereof on the internal surface of the elastomeric film, and
- a barrier film layer that provides separation between the antimicrobial agent and the skin-protective agent;

wherein the inner surface of the film is free of an antimicrobially-effective amount of an antimicrobial agent that is effective against both beneficial and harmful microorganisms.

In another aspect, there is provided a method for the manufacture of an elastomeric article, the method comprising:

- providing an elastomeric film comprising one or more film layers, the elastomeric film including first and second opposing surfaces;
- introducing an antimicrobial agent that is effective against both beneficial and harmful microorganisms onto or into the first opposing surface in a manner so as to avoid the antimicrobial agent from being introduced onto or into the second opposing surface;
- introducing a skin-protective agent selected from a probiotic, a prebiotic, or a combination thereof onto or into the second opposing surface; and
- providing a barrier film layer in the elastomeric film that provides separation between the antimicrobial agent and the skin-protective agent,
- wherein the second opposing surface of the elastomeric article produced by the method is free of an antimicrobially-effective amount of antimicrobial agent.

In another aspect, there is provided a method for the manufacture of an elastomeric article, the method comprising:

- providing an elastomeric film comprising one or more film layers, the elastomeric film including first and second opposing surfaces;
- introducing an antimicrobial agent that is effective against both beneficial and harmful microorganisms onto or into the first opposing surface in a manner so as to avoid the antimicrobial agent from being introduced onto or into the second opposing surface; and
- providing a barrier film layer between the antimicrobial agent on the first opposing surface of the elastomeric film and the second opposing surface of the film, to prevent contact between the antimicrobial agent on the first opposing surface of the elastomeric film and skin that comes into contact with the second opposing surface of the article,
- wherein the second opposing surface of the elastomeric article produced by the method is free of an antimicrobially-effective amount of an antimicrobial agent.

According to another preferred example, there is provided a method for the manufacture of an elastomeric article, the method comprising:

- providing an elastomeric film comprising one or more film layers, the elastomeric film including first and second opposing surfaces;
- introducing an antimicrobial agent that is effective against both beneficial and harmful microorganisms onto or into the first opposing surface in a manner so as to avoid the antimicrobial agent from being introduced onto or into the second opposing surface;
- introducing a skin-protective agent selected from a probiotic, a prebiotic, or a combination thereof onto or into the second opposing surface; and
- providing a barrier film layer in the elastomeric film that provides separation between the antimicrobial agent and the skin-protective agent.

In the course of preparing the above films, the applicant has additionally found that very effective articles that are antimicrobial while avoiding excessive irritation to the skin can be prepared without any skin-protective agent on the inner surface. In such instances, care must be taken to ensure that the antimicrobial agent is applied to the external surface of the article, and a barrier layer is also required. In another aspect, there is accordingly provided an elastomeric article comprising:

- an elastomeric film comprising one or more film layers, and including an external surface and an internal surface;
- an antimicrobial agent that is effective against both beneficial and harmful microorganisms on the external surface of the elastomeric film; and
- a barrier film layer between the antimicrobial agent on the external surface of the elastomeric film and the internal surface, to prevent or minimise contact between the antimicrobial agent on the external surface of the elastomeric film and skin that comes into contact with the internal surface of the article, wherein the internal surface of the film is free of an antimicrobially-effective amount of an antimicrobial agent that is effective against both beneficial and harmful microorganisms.

The reference to skin that comes into contact with the internal surface of the article refers to skin that, in use, comes into contact with the inner surface of the article.

According to the present disclosure, there is provided an elastomeric glove produced by the methods described above.

CLAIMS:

1. An elastomeric article comprising:

- an elastomeric film comprising one or more film layers, and including an external surface and an internal surface,
- an antimicrobial agent that is effective against both beneficial and harmful microorganisms on the external surface of the elastomeric film,
- a skin-protective agent selected from a probiotic, a prebiotic, or a combination thereof on the internal surface of the elastomeric film, and
- a barrier film layer that provides separation between the antimicrobial agent and the skin-protective agent,

wherein the internal surface of the film is free of an antimicrobially-effective amount of an antimicrobial agent that is effective against both beneficial and harmful microorganisms.

2. The elastomeric article of claim 1, wherein the barrier layer is a barrier film layer or a barrier coating layer.

3. The elastomeric article of any one of claims 1 to 2, wherein the elastomeric film is a single layer film.

4. The elastomeric article of any one of claims 1 to 2, wherein the elastomeric film is a multilayer film comprising a first film layer that defines the external surface of the article and a second film layer that defines the internal surface of the article.

5. The elastomeric article of claim 4, wherein the antimicrobial agent is present within the first film layer.

6. The elastomeric article of claim 5, wherein the antimicrobial agent is present in the first film layer through incorporation into a coagulant used in the production of the elastomeric article, or through incorporation into an elastomeric film-forming composition used to produce the first film layer.

7. The elastomeric article of claim 6, wherein the amount of antimicrobial agent in the first film layer is 0.01 to 20 phr.

8. The elastomeric article of any one of claims 1 to 6, wherein the article comprises a coating layer on the external surface of the article, and the coating layer on the external surface comprises the antimicrobial agent.

9. The elastomeric article of any one of claims 1 to 8, wherein the skin-protective agent is present in a coating on the internal surface of the elastomeric film.

10. The elastomeric article of any one of claims 1 to 9, wherein the article comprises a coating layer on the internal surface of the article, and the coating layer on the internal surface comprises the skin-protective agent.

11. The elastomeric article of claim 10, wherein the coating layer constitutes about 0.001% to about 30% by weight of the total weight of the article.

12. The elastomeric article of claim 10 or claim 11, wherein the total amount of the skin-protective agent in the coating layer is at least 5% by weight of the coating layer.

13. The elastomeric article of any one of claims 1 to 12, wherein the antimicrobial agent is selected from the group consisting of pyrithiones, phenolic compounds, heterocyclic compounds, quaternary ammonium salts, biguanide compounds, parabens, antibiotics, antivirals, antifungals, antimicrobial peptides and combinations of one or more thereof.

14. The elastomeric article of claim 13, wherein the antimicrobial agent is selected from the group consisting of pyrithiones, phenolic compounds, and combinations thereof.

15. The elastomeric article of any one of claims 1 to 14 wherein the skin-protective agent comprises a probiotic is selected from the group consisting of *Lactobacillus*, *Lactococcus*, *Bifidobacterium*, and combinations thereof.

16. The elastomeric article of any one of claims 1 to 15 wherein the skin-protective agent comprises a probiotic in the form of a ferment lysate or extract.

17. The elastomeric article of any one of claims 1 to 16, wherein the skin-protective agent comprises a prebiotic selected from the group consisting of saccharides, phytosphingosine and derivatives or salts thereof, lactic acid, glycomacropeptide, amino acids, peptides and combinations or salts thereof.

18. The elastomeric article of claim 17, wherein the prebiotic comprises a saccharide selected from the group consisting of alpha-glucan, beta-glucan, fructooligosaccharides, inulin, and combinations thereof.

19. The elastomeric artice of any one of claims 1 to 18, wherein the skinprotective agent comprises both the probiotic and the prebiotic.

20. The elastomeric article of any one of claims 1 to 19, wherein the elastomeric film comprises an elastomer selected from the group consisting of natural rubber, nitrile rubber, silicone rubber, polyvinyl chloride, polyethylene, polypropylene, polyurethane, polyisoprene, polychloroprene, polystyrene, acrylic polymers, polybutadienes, fluoroelastomers, copolymers or blends of these polymers or their monomers, and derivatives or blends thereof.

21. The elastomeric article of any one of claims 1 to 20, wherein the elastomeric film comprises an elastomer selected from the group consisting of natural rubber, nitrile rubber, polyisoprene, polychloroprene, polyurethane, copolymers or blends of these polymers or their monomers, and derivatives or blends thereof.

22. The elastomeric article of any one of claims 1 to 21, in the form of a glove, finger cot or footwear.

23. The elastomeric article of any one of claims 1 to 22, wherein the article has an average thickness of between 0.01 and 3.0 mm.

24. The elastomeric article of any one of claims 1 to 23, with:

- a modulus at 500% stretch of less than 15 MPa,
- a modulus at 300% stretch of less than 10 MPa,
- a tensile strength of at least 8 MPa; and/or
- an elongation to break of at least 200%.

25. A method for the manufacture of an elastomeric article, the method comprising:

- providing an elastomeric film comprising one or more film layers, the elastomeric film including first and second opposing surfaces;
- introducing an antimicrobial agent that is effective against both beneficial and harmful microorganisms onto or into the first opposing surface in a manner so as to avoid the antimicrobial agent from being introduced onto or into the second opposing surface;

- introducing a skin-protective agent selected from a probiotic, a prebiotic, or a combination thereof onto or into the second opposing surface; and
- providing a barrier film layer in the elastomeric film that provides separation between the antimicrobial agent and the skin-protective agent,
- wherein the second opposing surface of the elastomeric article produced by the method is free of an antimicrobially-effective amount of antimicrobial agent.

26. The method of claim 25, comprising incorporating the barrier layer into the elastomeric article as a barrier film layer or a barrier coating layer.

27. The method of claim 26, the method comprising producing a first film layer from a first elastomeric film-forming composition which comprises the antimicrobial agent so as to result in the introduction of the antimicrobial agent into the first opposing surface of the article, and producing the barrier film layer as a separate layer of the elastomeric film.

28. The method of claim 27, comprising dipping a mould into the first elastomeric film-forming composition to produce the first film layer, and dipping the mould into a second elastomeric film-forming composition to form the barrier film layer.

29. The method of claim 27 or claim 28, comprising incorporating the antimicrobial agent into the first elastomeric film-forming composition in an amount of from 0.01 to 20 phr.

30. The method of claim 26, the method comprising:

- dipping a mould into a coagulant composition comprising the antimicrobial agent and dipping the coagulant-dipped mould into a first elastomeric film-forming composition to produce a first film layer of the elastomeric film, the dipping steps resulting in the incorporation of the antimicrobial agent into the first film layer; and
- dipping the mould with the first film layer into a second elastomeric film-forming composition to form the barrier film layer.

31. The method of claim 30, comprising incorporating the antimicrobial agent into the coagulant composition in an amount of from about 0.01% to about 50% by weight of the coagulant composition.

32. The method of any one of claims 25 to 31, comprising coating a coating composition comprising the antimicrobial agent onto the first opposing surface of the elastomeric film.

33. The method of claim 32, comprising spray coating or tumble coating the coating composition onto the first opposing surface of the elastomeric film.

34. The method of any one of claims 25 to 33, comprising coating a coating composition comprising the skin-protective agent onto the second opposing surface of the elastomeric film.

35. The method of claim 34, comprising coating a coating composition comprising a skin-protective agent in an amount of between about 0.01% and about 50% by weight of the coating composition onto the second opposing surface of the elastomeric film.

36. The method of claim 34, comprising coating a coating composition comprising a skin-protective agent in an amount of between about 0.01% and about 30% by weight of the coating composition onto the second opposing surface of the elastomeric film.

37. The method of claim 35 or claim 36, comprising dip coating, spray coating or tumble coating the coating composition onto the second opposing surface of the elastomeric film.

38. The method of any one of claims 34 to 37, wherein the coating composition coated onto the second opposing surface of the elastomeric film comprises:

- 0.01 – 20% by weight of the skin-protective agent;
- optionally one or more of a dispersing agent, an emulsifier, a solubiliser, a rheology modifier, a wetting agent, an emollient, a skin conditioning agent, a humectant, a preservative, silicone, fragrance and a pH adjustor; and
- water.

39. The method of any one of claims 34 to 38, comprising applying the coating composition comprising the skin-protective agent onto the elastomeric film by dipping or spray coating in an online process prior to curing of the elastomeric film.

40. The method of any one of claims 28 to 31, comprising dipping the mould with the first elastomeric film layer comprising the antimicrobial agent and the barrier layer into a third elastomeric film-forming composition comprising the skin-protective agent, to produce a third film layer comprising the skin-protective agent.

41. The method of claim 40, wherein the step of dipping the mould into the third elastomeric film-forming composition comprises dipping into a third elastomeric film-forming composition comprising 0.01 – 50 phr of skin-protective agent.

42. The method of claim 25, comprising applying a coating composition comprising the antimicrobial agent onto the first surface of the elastomeric film, and applying a coating composition comprising the skin-protective agent onto the second opposing surface of the elastomeric film.

43. The method of any one of claims 25 to 42, wherein the skin-protective agent comprises a probiotic in the form of a ferment lysate or extract.

44. The method of any one of claims 25 to 43, wherein the skin-protective agent comprises both the probiotic and the prebiotic.

45. An elastomeric article comprising:

- an elastomeric film comprising one or more film layers, and including an external surface and an internal surface;
- an antimicrobial agent that is effective against both beneficial and harmful microorganisms on the external surface of the elastomeric film; and
- a barrier film layer between the antimicrobial agent on the external surface of the elastomeric film and the internal surface, to prevent contact between the antimicrobial agent and skin that comes into contact with the internal surface of the article, wherein the internal surface of the film is free of an antimicrobially-effective amount of an antimicrobial agent that is effective against both beneficial and harmful microorganisms.

46. A method for the manufacture of an elastomeric article, the method comprising:

- providing an elastomeric film comprising one or more film layers, the elastomeric film including first and second opposing surfaces;
- introducing an antimicrobial agent that is effective against both beneficial and harmful microorganisms onto or into the first opposing surface in a manner so as to avoid the antimicrobial agent from being introduced onto or into the second opposing surface; and

- providing a barrier film layer between the antimicrobial agent on the first opposing surface of the elastomeric film and the second opposing surface of the film, to prevent contact between the antimicrobial agent on the first opposing surface of the elastomeric film and skin that comes into contact with the second opposing surface of the article,
- wherein the second opposing surface of the elastomeric article produced by the method is free of an antimicrobially-effective amount of an antimicrobial agent.

47. The elastomeric article produced by any one of claims 25 to 44 and 46.