CLAIMS

1. A method for forming a water, oil, and/or gas resistant and/or impermeable product, the method comprising:

    (a) coating a product with a composition, the composition comprising:

        a protein, wherein the protein, is a plant-derived protein, an animal-derived protein, a fungus-derived protein, or any combination thereof; and/or

        shellac; and

    (b) heating the coated product to form a water, oil, and/or gas resistant and/or impermeable product.

2. A method as claimed in claim 1, wherein the product comprises a cellulose-based product such as a paper-, cardboard- or wood-based product.

3. A method as claimed in claim 1 or 2, wherein the composition comprises a solvent.

4. A method as claimed in claim 3, wherein the solvent comprises water, one or more carboxylic acids, one or more alcohols, and/or any combination thereof, optionally wherein the solvent comprises water, methanol, ethanol, isopropanol, butanol, ethylene glycol, methanoic acid, ethanoic acid, propanoic acid, or any combination thereof.

5. A method as claimed in any of claims 1 to 4, wherein the composition comprises a protein, and the protein comprises:

    a plant-derived protein, optionally wherein the plant-derived protein comprises prolamine protein; or

    an animal-derived protein, optionally wherein the protein is a dairy protein, egg protein, poultry protein, livestock protein, or any combination thereof, optionally wherein the protein comprises whey protein; or

    a fungus-derived protein, optionally wherein the protein is a chytridiomycota protein, a zygomycota protein, a glomeromycota protein, a ascomycota protein, a basidiomycota protein, or any combination thereof.

6. A method as claimed in claim 5, wherein the protein comprises a plant-derived protein and wherein the plant-derived protein comprises a vegetable protein, nut protein, seed protein, legume protein, bean protein, pulse protein, grass protein, or any combination thereof, optionally wherein the protein comprises corn protein, pea protein, soy protein,

oat protein, chickpea protein, wheat protein, barley protein, rye protein, sorghum protein, or any combination thereof, optionally wherein the protein comprises corn protein, optionally wherein the corn protein is zein protein.

7. A method as claimed in any one of claims 1 to 4, wherein the composition comprises:

    a protein and does not comprise shellac; or

    shellac and does not comprise a protein.

8. A method as claimed in any preceding claim, wherein the product is coated with the composition by spraying the composition onto the product, soaking the product in the composition, dipping the product in the composition, roller coating the composition onto the product, brushing the composition onto the product, wiping the composition onto the product, impregnating the product with the composition by padding, exhausting the composition on the product, flowing the composition onto the product, the use of slit coating techniques, the use of blade application techniques, or any combination thereof.

9. The method as claimed in any preceding claim, wherein heating the coated product to form a water, oil, and/or gas resistant and/or impermeable product is carried out using:

    one or more gas burners, oil burners, electrically heated filaments, any combination thereof; and/or

    one or more infra-red (IR) heating devices.

10. A method as claimed in any preceding claim, wherein heating the coated product comprises heating:

    to a temperature between 200 °C and 500 °C, optionally to a temperature of approximately 200 °C, approximately 210 °C, approximately 220 °C, approximately 230 °C, approximately 240 °C, approximately 250 °C, approximately 260 °C, approximately 270 °C, approximately 280 °C, approximately 290 °C or approximately 300 °C; and/or

    for a period of from 5 seconds to 1 hour, optionally for approximately 5 seconds, approximately 6 seconds, approximately 7 seconds, approximately 8 seconds, approximately 9 seconds, approximately 10 seconds, approximately 11 seconds, approximately 12 seconds, approximately 13 seconds, approximately 14 seconds, approximately 15 seconds, approximately 16 seconds, approximately 17 seconds, approximately 18 seconds, approximately 19 seconds, approximately 20 seconds, approximately 25 seconds, approximately 30 seconds, approximately 35 seconds, approximately 40 seconds, approximately 45 seconds, approximately 50 seconds,

approximately 55 seconds, approximately 60 seconds, approximately 1 minute, approximately 2 minutes, approximately 3 minutes, approximately 4 minutes, approximately 5 minutes, approximately 10 minutes, approximately 15 minutes, approximately 20 minutes, approximately 25 minutes, approximately 30 minutes, approximately 35 minutes, approximately 40 minutes, approximately 45 minutes, approximately 50 minutes, approximately 55 minutes or approximately 1 hour.

11. A method as claimed in any preceding claim, wherein heating the coated product comprises heating to a first temperature for a first period of time, then heating the coated product to a second temperature for a second period of time, wherein the first period of time is longer than, equal to or shorter than the second period of time.

12. A method as claimed in claim 11, wherein the first temperature is higher than or lower than the second temperature, optionally wherein the temperature to which the product is heated in the first period is. or is up to, 5 ^{o}C, 10 ^{o}C, 15 ^{o}C, 20 ^{o}C, 25 ^{o}C, 30 ^{o}C, 35 ^{o}C, 40 ^{o}C, 45 ^{o}C, 50 ^{o}C, or more than 50 ^{o}C, different to the temperature to which the product is heated in the second period.

13. A method as claimed in any preceding claim, wherein the composition further comprises a functional additive, optionally wherein the functional additive comprises a dye, a pigment, a pH sensitive material, a temperature sensitive material, a conductive material, a fluorescent material, a sol comprising an alkoxide and a solvent, or combinations thereof.

14. A method as claimed in claim 13, wherein the functional additive comprises nanocellulose or microcellulose.

15. A method as claimed in any preceding claim, wherein the composition does not comprise:

an alkoxide; or

a catalyst, optionally wherein the composition does not comprise an acid and/or does not comprise a base; or

an ester; or

a glycol and/or does not comprise a polyol; or

a polysaccharide; or

a synthetic polymer; or

a sol and/or a sol gel; or

a stabiliser; or

a plasticiser.

16. A water, oil, and/or gas resistant and/or impermeable product formed by a method as claimed in any preceding claim.

17. A water, oil, and/or gas resistant and/or impermeable product as claimed in claim 16, wherein the water, oil, and/or gas resistant and/or impermeable product comprises a cellulose-based product such as a paper-, cardboard- or wood-based product.

18. A water, oil, and/or gas resistant and/or impermeable product as claimed in claim 17, wherein the water, oil, and/or gas resistant and/or impermeable product:

forms part or all of a container for use in the food and beverages industry, optionally wherein the water, oil, and/or gas resistant and/or impermeable product forms a lid; or

is an item of cutlery or a cooking utensil.

19. A water, oil, and/or gas resistant and/or impermeable product as claimed in any of claims 16 to 18 when dependent on claim 13, wherein the functional additive comprises a dye or a pigment such that the water, oil, and/or gas resistant and/or impermeable product is a coloured product.

20. A water, oil, and/or gas resistant and/or impermeable product as claimed in any of claims 16 to 19, wherein the water, oil, and/or gas resistant and/or impermeable product has an increased tensile strength, increased dimensional stability, increased scratch resistance, improved smoothness, and/or improved antifouling properties relative to the corresponding uncoated product used in a method as claimed in any preceding claim.