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(71) Applicant: **DUPONT NUTRITION BIOSCIENCES APS** [DK/DK]; LANGEBROGADE 1, DK 1411 COPENHAGEN K (DK).

(71) Applicant (for SC only): **DANISCO USA INC** [US/US]; 4 New Century Pkwy, New Century, Kansas 66031 (US).

(72) Inventor: **ZHONG, Ying J.**; c/o Danisco USA Inc., 4 New Century Parkway, New Century, Kansas 66031 (US).

(74) Agent: **GRYTE, David M.**; Chestnut Run Plaza, 721/2306, 974 Centre Road, Wilmington, Delaware 19805 (US).

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(54) Title: PROCESS FOR REDUCING OXIDATION OF A FOODSTUFF AND RELATED COMPOSITIONS

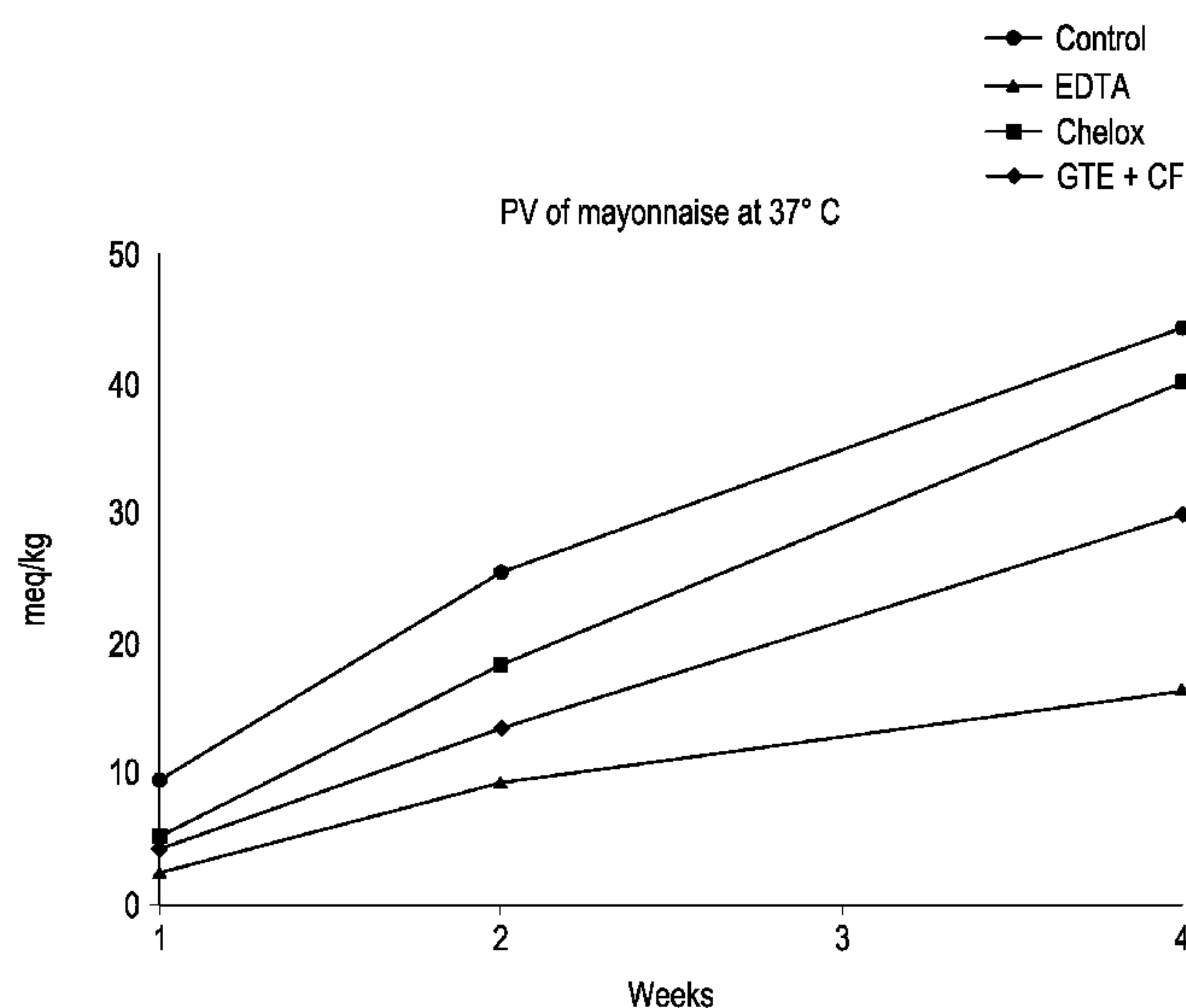


FIG. 1

(57) Abstract: This specification relates to a process for reducing oxidation of a foodstuff, an antioxidant composition for use in such a process, and a foodstuff wherein oxidation is reduced by such a process.

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CROSS REFERENCE TO RELATED PATENT APPLICATIONS

5 **[1]** This specification claims priority to US Provisional Patent Application No. 62/935,957 filed (November 15, 2019) and European Patent Application No. EP19216501.7 (filed December 16, 2019). The entire text of each of the above-referenced patent applications is incorporated by reference into this specification.

10 FIELD

[2] This specification relates to a process for reducing oxidation of a foodstuff, an antioxidant composition for use in such a process, and a foodstuff wherein oxidation is reduced by such a process.

15 BACKGROUND

[3] Antioxidants are widely used in food products susceptible to oxidative degeneration. An antioxidant is defined by the US Food and Drug Administration (21 CFR 170.3) as "a substance used to preserve food by retarding deterioration, rancidity, or discoloration due to oxidation". There is an increasing need to develop economical, natural and effective food preservative systems to meet the public demand for convenient, natural, safe, healthy and good quality food products with a more reliable shelf life. To this end, spices or plant extracts can be used in food as antioxidants and to impart flavor. One advantage of such extracts is that they are perceived as natural ingredients when compared to, for example, ethylenediaminetetraacetic acid ("EDTA"), butyl hydroxyanisol ("BHA") or butylated hydroxytoluene ("BHT").

[4] There is large number of known antioxidants based on naturally occurring plant materials. These materials have varying degrees of efficacy. For some of these materials, obtaining the antioxidant levels required to ensure preservation of foodstuffs may prove to uneconomical, or are above concentrations acceptable under various regulatory constraints. And, for some materials, the amount required to reach the desired antioxidant level can have an undesirable sensory impact.

[5] The effectiveness of an antioxidant may be dependent on various factors, including, for example, its strength (*i.e.*, its intrinsic antioxidant activity of the molecule), dosage and the application media. The environment can play an important role in the efficacy of

an antioxidant, which may behave differently in bulk lipid and multiphase colloids. Under certain conditions, an antioxidant may act as a prooxidant; this is believed to be related to its localization/distribution and active concentration in the different phases (oil, water or interface) of the medium.

5

SUMMARY

[6] This specification provides a process to reduce oxidation of a foodstuff, an antioxidant composition useful in such a process, and a foodstuff in which oxidation has been reduced by such a process. This process generally can be useful for increasing the shelf-life and customer satisfaction of a foodstuff. It uses natural and relatively inexpensive ingredients in amounts that typically cause little or no discoloration to the foodstuff or a negative impact on flavor (and may, in some instances, add a pleasant or otherwise desired flavor).

[7] Briefly, this specification discloses, in part, a process for reducing oxidation of a foodstuff. The process comprises contacting a foodstuff with a green tea [*Camellia sinensis*] extract and a citrus fiber. In some embodiments, the process comprises contacting a foodstuff with an antioxidant composition comprising a green tea [*Camellia sinensis*] extract and a citrus fiber.

[8] This specification also discloses, in part, an antioxidant composition for use in reducing oxidation of a foodstuff, wherein the antioxidant composition comprises a green tea [*Camellia sinensis*] extract and a citrus fiber.

[9] This specification also discloses, in part, a foodstuff. The foodstuff is protected from oxidation by a process as discussed in this specification. Here, protection of the foodstuff from oxidation means the onset of oxidation in the foodstuff is delayed and/or the rate of oxidation of the foodstuff is reduced or oxidation of the foodstuff is prevented.

[10] This specification also discloses, in part, a preserved foodstuff composition. The preserved foodstuff composition comprises a foodstuff and an antioxidant composition. The antioxidant composition comprises a green tea [*Camellia sinensis*] extract and a citrus fiber.

[11] This specification also discloses, in part, a kit. The kit comprises: (i) a green tea [*Camellia sinensis*] extract, (ii) a citrus fiber, and (iii) instructions for contacting the green tea [*Camellia sinensis*] extract with a foodstuff to reduce oxidation of the foodstuff.

[12] Further benefits of the teachings of this specification will be apparent to one skilled in the art from reading this specification.

BRIEF DESCRIPTION OF THE FIGURES

[13] **Figure 1** shows peroxide values (PV) of the mayonnaise formulations tested in **Example 1** after 1, 2 and 4 weeks of storage at 37°C.

5 [14] **Figure 2** shows TBARS values of the mayonnaise formulations tested in **Example 1** after 1, 2 and 4 weeks of storage at 37°C.

DETAILED DESCRIPTION

[15] This detailed description is intended to acquaint others skilled in the art with Applicant's invention, its principles, and its practical application so that others skilled in the art may adapt and apply Applicant's invention in its numerous forms, as they may be best suited to the requirements of a particular use. This detailed description and its specific examples, while indicating certain embodiments, are intended for purposes of illustration only. This specification, therefore, is not limited to the described embodiments, and may be variously modified.

15 [16] This specification provides, in part, a combination of components for reducing oxidation in a foodstuff.

[17] As used herein, the term "antioxidant" means a substance that reduces the amount of oxidation over a given period when compared to the oxidation that would have occurred in the absence of that substance. This reduction in oxidation can be manifested as a delay in the onset of oxidation and/or a reduction in the rate of oxidation or complete prevention of oxidation.

[18] The term "flavorant" means a substance that alters or enhances the taste of a foodstuff when compared to the taste of the foodstuff in the absence of that substance.

25 *Green Tea Extract*

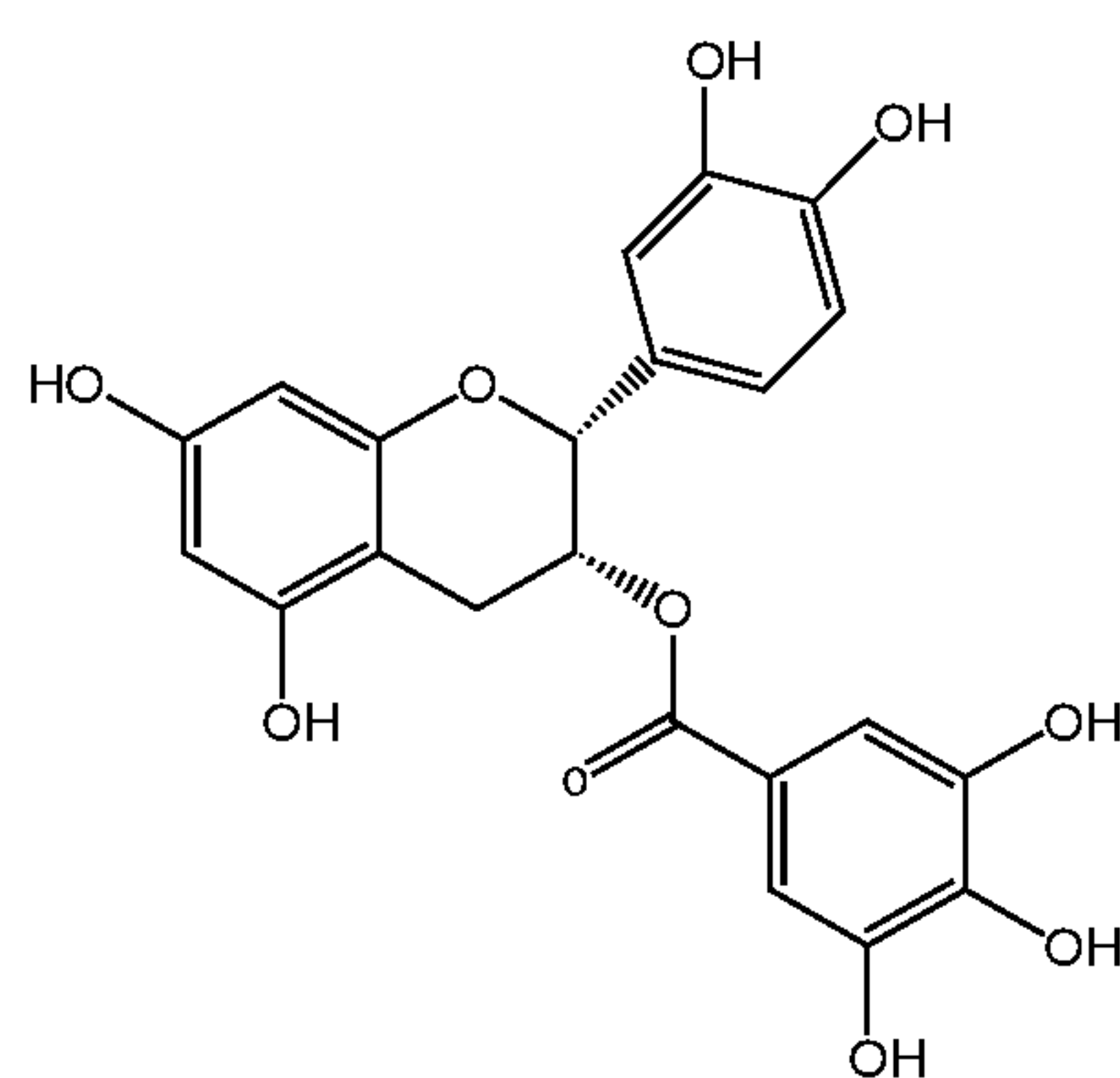
[19] One component of the antioxidant of this specification is green tea [*Camellia sinensis*] extract.

[20] The term "extract" means any constituent of a plant that may be isolated from the plant or a part of the plant.

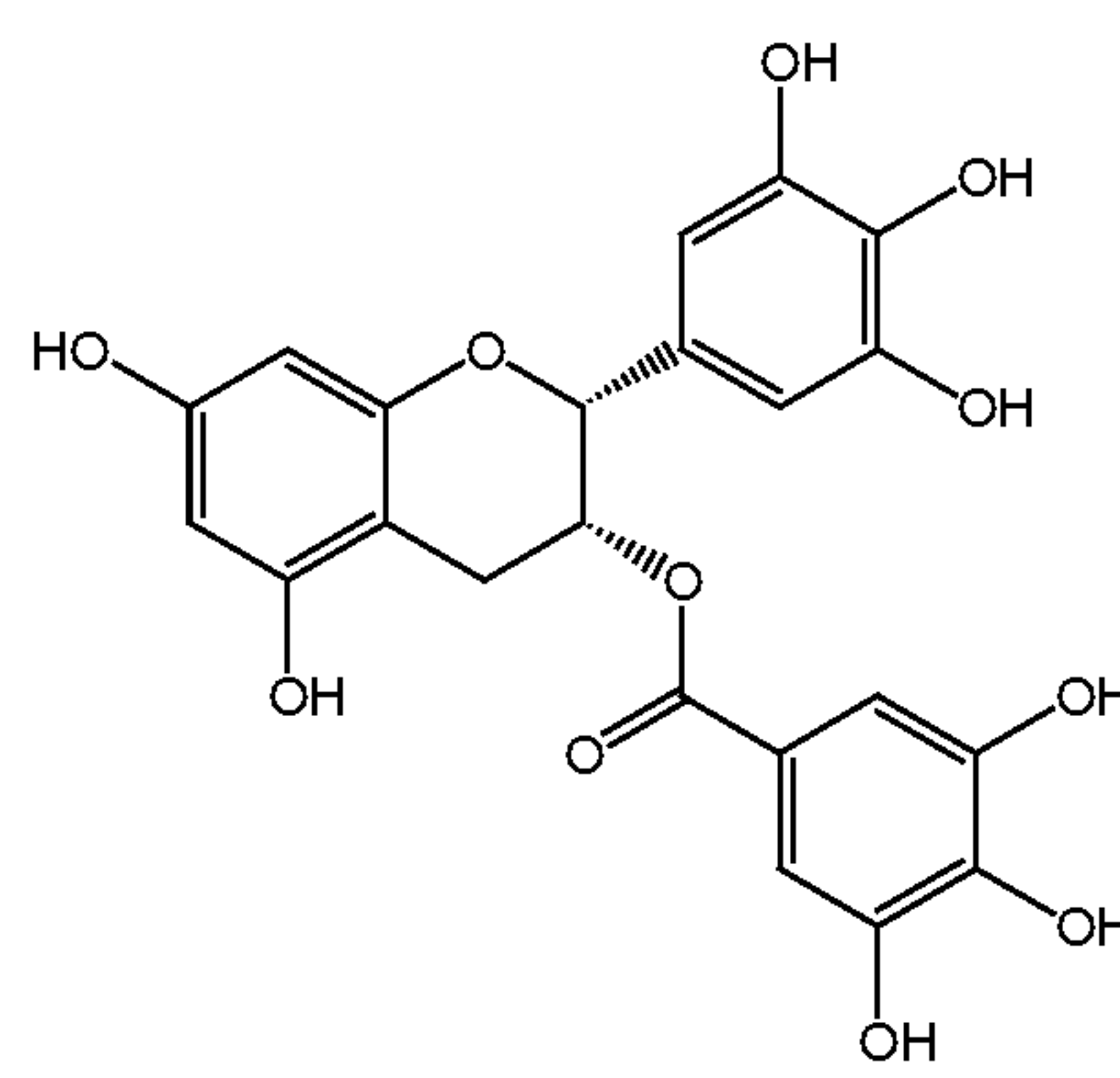
30 [21] All term "green tea extract" (or "GTE") in this specification means an extract from a plant of the species *Camellia sinensis*. The extract generally comprises an extract from a leaf and/or bud of *Camellia sinensis* or a constituent isolated from such a leaf and/or bud. In some embodiments, the GTE comprises an extract from a *Camellia sinensis* leaf. In some

embodiments, the GTE comprises a constituent that has been extracted from a *Camellia sinensis* leaf.

[22] Green tea extracts are generally soluble in water and insoluble in oil. Numerous *in vitro* and *in vivo* studies have suggested the beneficial health properties of green tea (*Camellia sinensis*) and tea polyphenols, including antioxidant and antimicrobial activity. *See, e.g.*, Kubo, I., et al., “Antimicrobial activity of green tea flavor components and their combination effects”, *Journal of Agricultural and Food Chemistry*, vol. 40, pp. 245–48 (1992). Catechins are a class of flavonoids, and a major component of green tea. Catechins and their gallates are reported to have antimicrobial and antioxidant activity, with the substances having an *epi*- configuration being particularly active. *See, e.g.*, Yam, T.S., et al., “Microbiological activity of whole and fractionated crude extracts of tea (*Camellia sinensis*), and of tea components”. *FEMS Microbiol. Lett.*, vol. 152, pp. 169–74 (1997); Kajiya, K, et. al., “Steric effects on interaction of tea catechins with lipid bilayers”, *Bioscience, Biotechnology and Biochemistry*, vol. 65, pp. 2638–43 (2001). In general, the antioxidant activity in a GTE is primarily due to four catechins, with the main components being epigallocatechin gallate (“EGCg”) and epicatechin gallate (“ECg”).

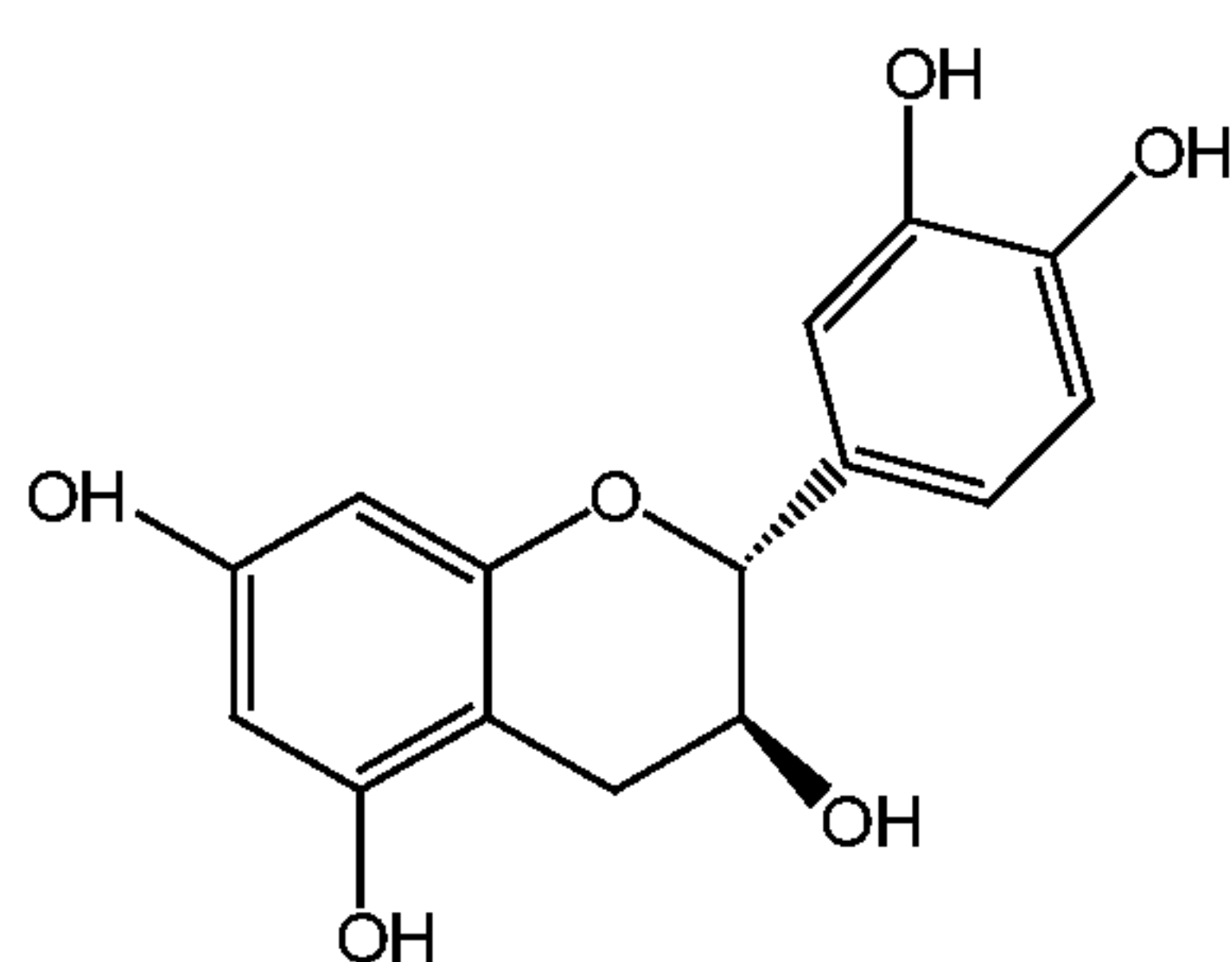


(-)-epicatechin gallate

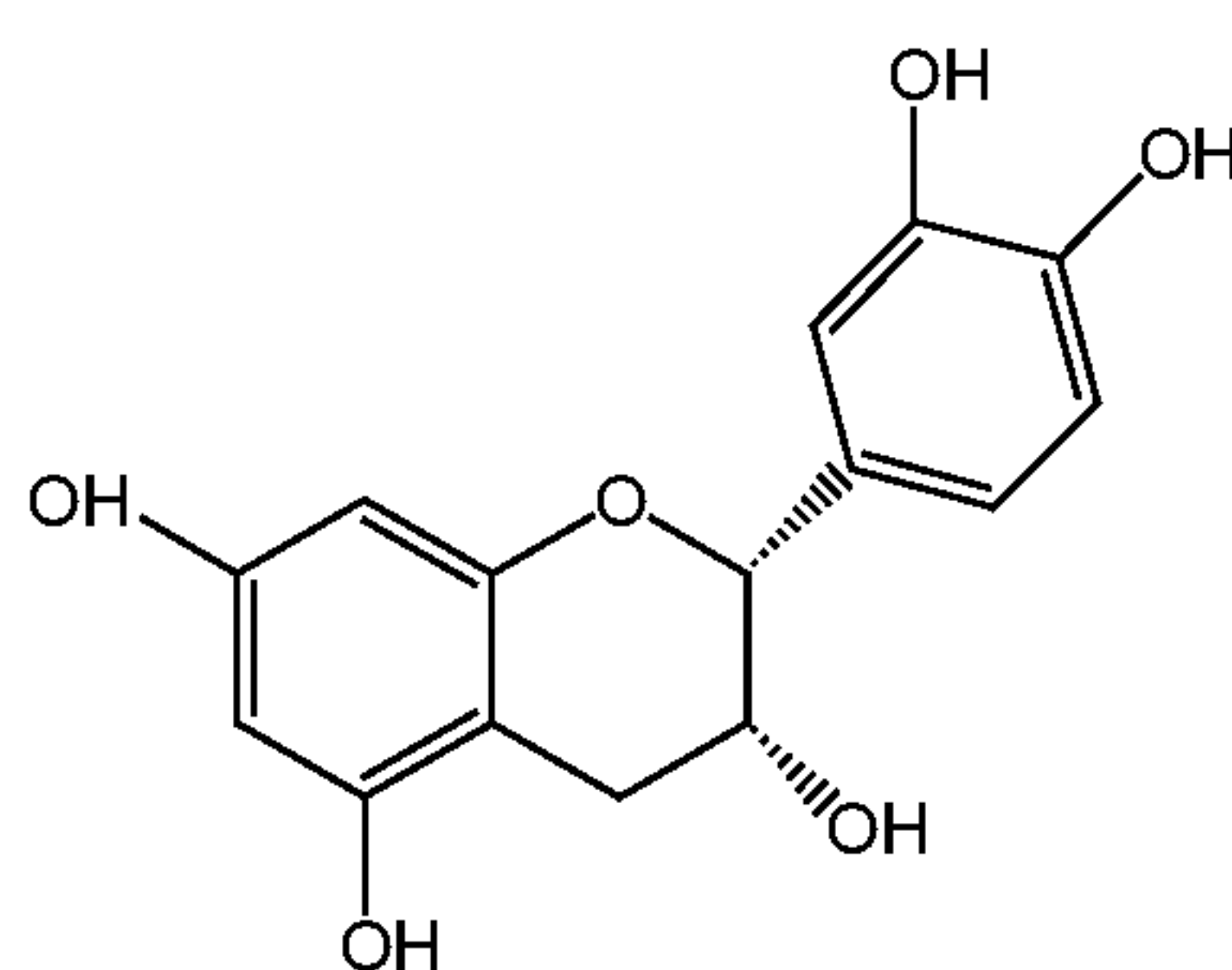


(-)-epigallocatechin gallate

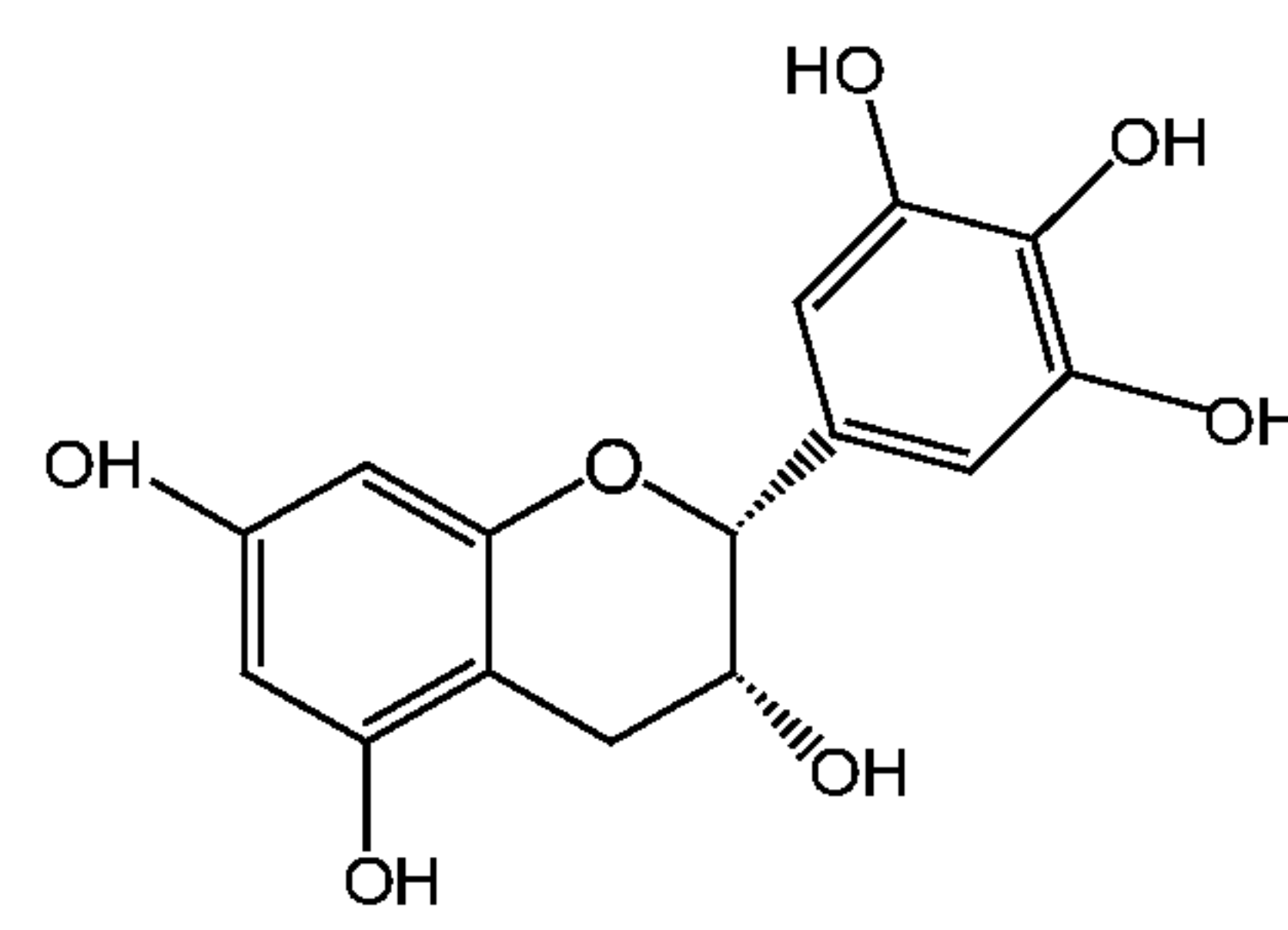
[23] In some embodiments, the GTE comprises a tea polyphenol. In some embodiments, the GTE comprises a catechin. In some embodiments, the GTE comprises:



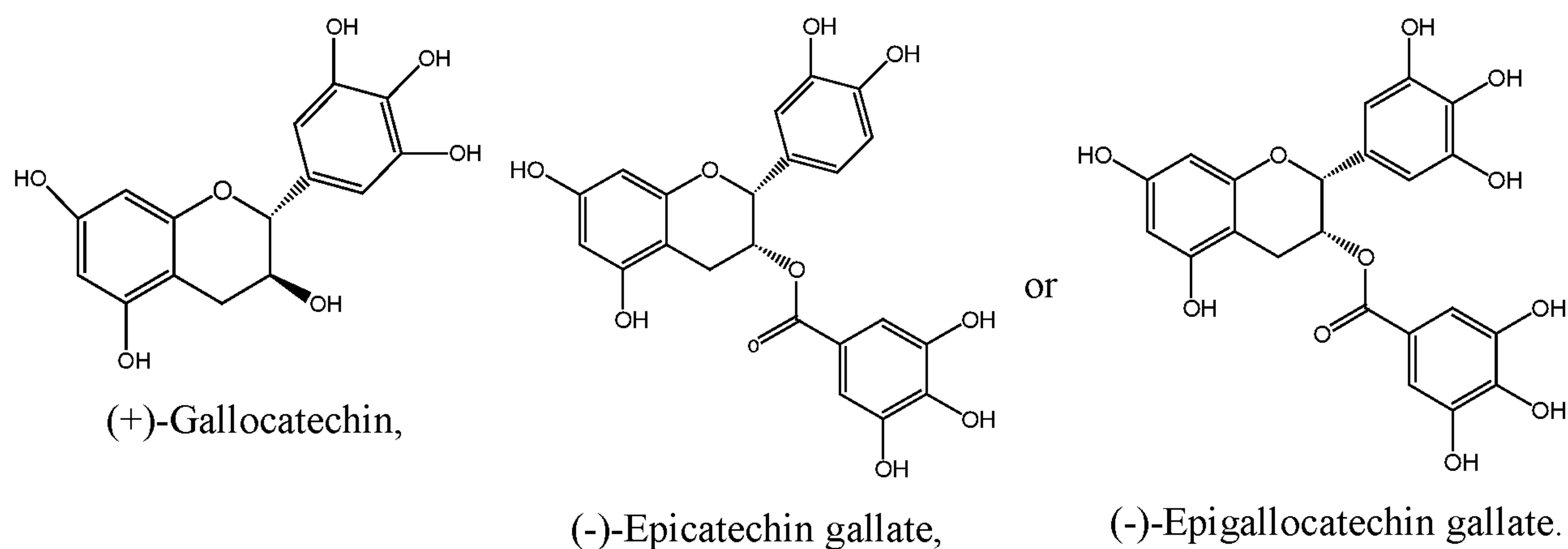
(+)-Catechin,



(-)-Epicatechin,

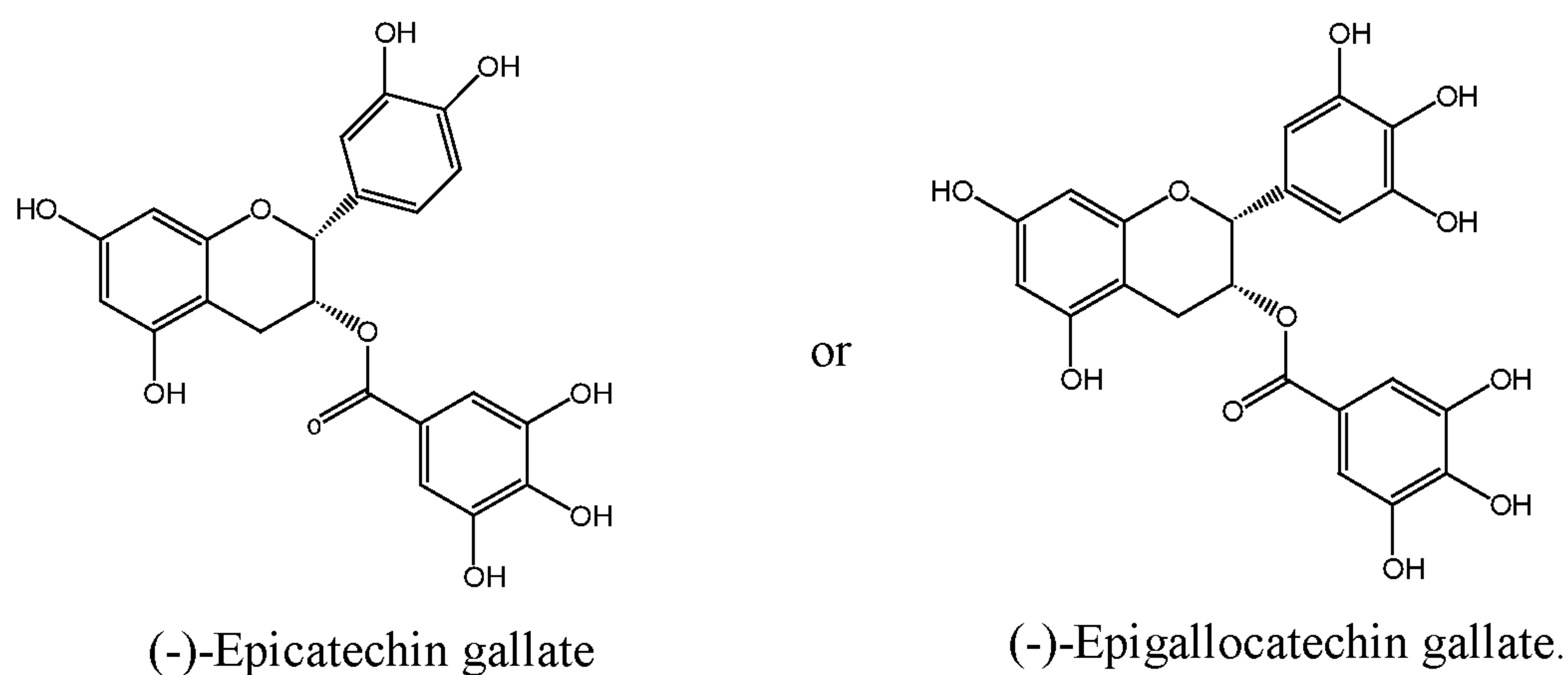


(-)-Epigallocatechin,



These compounds are sometimes referred to in this specification as “green tea catechins” or “green tea extract catechins.” A GTE may, for example, comprise these six catechins in a combined concentration of approximately 75% (by weight), based on the GTE.

5 [24] In some embodiments, the GTE comprises:



[25] In general, the amount of GTE present in an antioxidant used in a process of this specification is an amount that provides a desired antioxidant effect on the foodstuff, taking into account the amount of the citrus fiber used as well. In some embodiments, the amount of GTE used does not negatively impact the flavor of the foodstuff.

[26] The amount of GTE used in a process or included in an antioxidant composition of this specification typically depends on the concentration of catechins in the GTE. To illustrate, the GTE concentrations discussed in the following paragraphs for an antioxidant composition of this specification are generally based on a GTE containing 80% (by weight) catechins. Using the teachings of this specification, a skilled artisan can modify these illustrative GTE concentrations to account for a GTE having a different catechin concentration.

[27] In some embodiments, the antioxidant composition comprises the GTE at a concentration of at least 0.1% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of at least 0.2% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of at least 0.5% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of at least 1% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of at least 2% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of at least 3% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of at least 4% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of at least 5% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of at least 10% (by weight), based on the total weight of the antioxidant composition.

[28] In some embodiments, the antioxidant composition comprises the GTE at a concentration of no greater than 40% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of no greater than 35% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of no greater than 30% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of no greater than 25% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of no greater than 20% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of no greater than 15% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of no greater than 12% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a

concentration of no greater than 11% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of no greater than 10% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of no greater than 8% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of no greater than 6% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of no greater than 5% (by weight), based on the total weight of the antioxidant composition.

[29] In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 0.1 to 20% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 0.2 to 20% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 0.5 to 20% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 1 to 20% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 2 to 20% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 3 to 20% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 4 to 20% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 5 to 20% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 7 to 20% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 10 to 20% (by weight), based on the total weight of the antioxidant composition.

[30] In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 0.1 to 15% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a

concentration of from 1 to 15% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 2 to 15% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 3 to 15% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 4 to 15% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 5 to 15% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 7 to 15% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 10 to 15% (by weight), based on the total weight of the antioxidant composition.

concentration of from 0.1 to 18% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 0.1 to 16% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 0.1 to 14% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 0.1 to 12% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 0.1 to 10% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 0.1 to 8% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 0.1 to 6% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a

concentration of from 0.1 to 5% (by weight), based on the total weight of the antioxidant composition.

[32] In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 1 to 18% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 1 to 16% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 1 to 14% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 1 to 12% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 1 to 10% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 1 to 8% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 1 to 6% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 1 to 5% (by weight), based on the total weight of the antioxidant composition.

[33] In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 0.1 to 10% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 0.2 to 10% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 0.5 to 10% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 1 to 10% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 2 to 10% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 3 to 10% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 4 to 10% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a

concentration of from 5 to 10% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 6 to 10% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 7 to 10% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 8 to 10% (by weight), based on the total weight of the antioxidant composition.

[34] In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 0.1 to 12% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 0.2 to 12% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 0.5 to 12% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 1 to 12% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 2 to 12% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 3 to 12% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 4 to 12% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 5 to 12% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 6 to 12% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 7 to 12% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 8 to 12% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 9 to 12% (by weight), based on the total weight of the antioxidant composition.

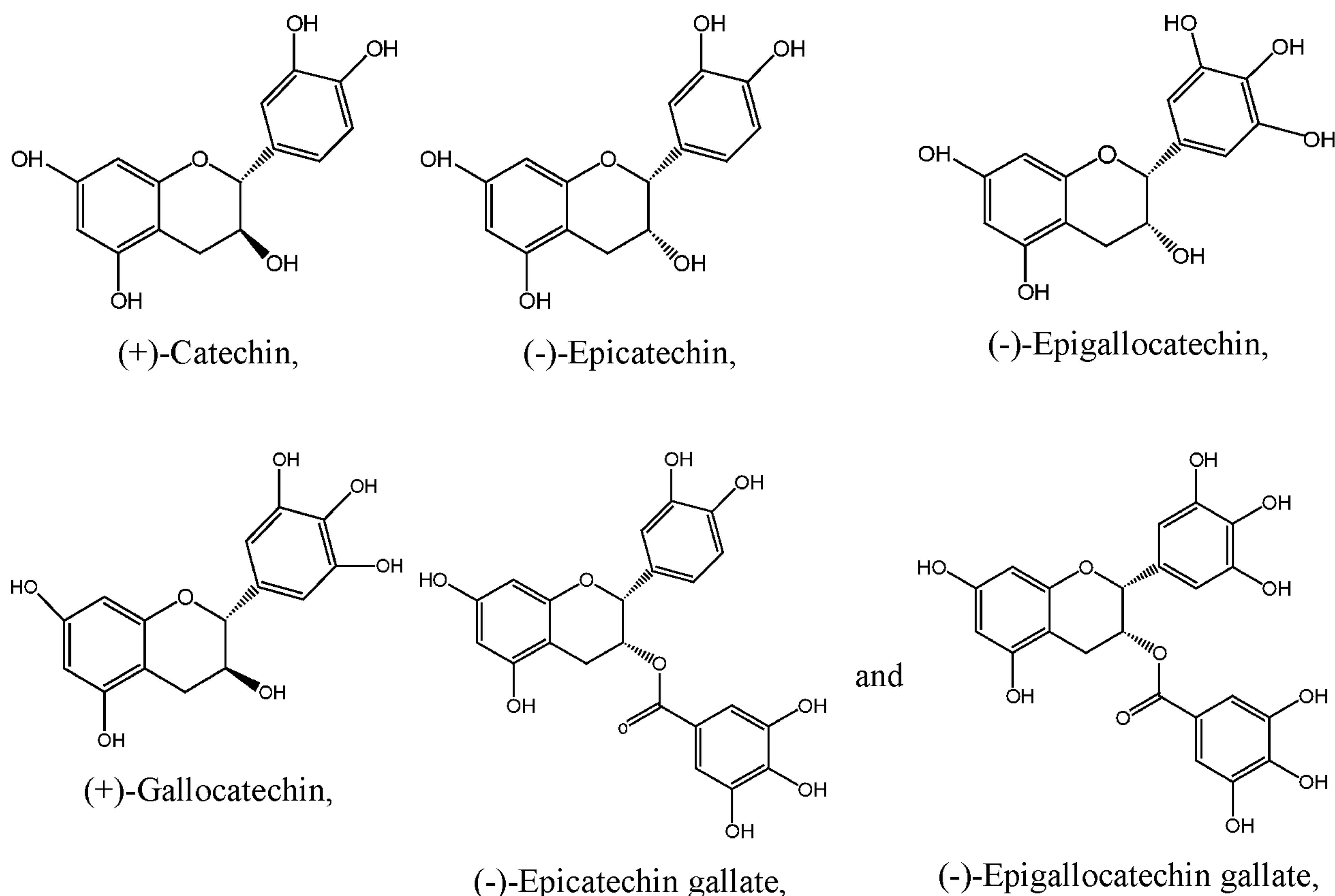
[35] In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 4 to 18% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 4 to 16% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 4 to 14% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 4 to 12% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 4 to 10% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 4 to 8% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 4 to 6% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 4 to 5% (by weight), based on the total weight of the antioxidant composition.

[36] In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 1.5 to 7% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 2 to 7% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 4 to 7% (by weight), based on the total weight of the antioxidant composition.

[37] In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 0.1 to 5% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 0.2 to 5% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 0.5 to 5% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 1 to 5% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 2 to 5% (by weight), based on the total weight of the antioxidant

composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 3 to 5% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the GTE at a concentration of from 4 to 5% (by weight), based on the total weight of the antioxidant composition.

[38] In some embodiments, the antioxidant composition comprises one or more green tea extract catechins selected from:



in a total concentration of at least 0.1% (by weight), based on the total weight of the antioxidant composition.

[39] In some embodiments, such green tea catechins are present in the antioxidant composition in a total concentration of at least 0.2% (by weight), based on the total weight of the antioxidant composition. In some embodiments, such green tea catechins are present in the antioxidant composition in a total concentration of at least 0.3% (by weight), based on the total weight of the antioxidant composition. In some embodiments, such green tea catechins are present in the antioxidant composition in a total concentration of at least 0.4% (by weight), based on the total weight of the antioxidant composition. In some embodiments, such green tea catechins are present in the antioxidant composition in a total concentration of at least 0.5% (by

weight), based on the total weight of the antioxidant composition. In some embodiments, such green tea catechins are present in the antioxidant composition in a total concentration of at least 1.0% (by weight), based on the total weight of the antioxidant composition. In some embodiments, such green tea catechins are present in the antioxidant composition in a total concentration of at least 1.5% (by weight), based on the total weight of the antioxidant composition. In some embodiments, such green tea catechins are present in the antioxidant composition in a total concentration of at least 2.0% (by weight), based on the total weight of the antioxidant composition.

[40] In some embodiments, such green tea catechins are present in the antioxidant composition in a total concentration of no greater than 20% (by weight), based on the total weight of the antioxidant composition. In some embodiments, such green tea catechins are present in the antioxidant composition in a total concentration of no greater than 15% (by weight), based on the total weight of the antioxidant composition. In some embodiments, such green tea catechins are present in the antioxidant composition in a total concentration of no greater than 10% (by weight), based on the total weight of the antioxidant composition.

[41] In some embodiments, such green tea catechins are present in the antioxidant composition in a total concentration of from 0.1 to 20% (by weight), based on the total weight of the antioxidant composition. In some embodiments, such green tea catechins are present in the antioxidant composition in a total concentration of from 0.1 to 15% (by weight), based on the total weight of the antioxidant composition. In some embodiments, such green tea catechins are present in the antioxidant composition in a total concentration of from 0.1 to 10% (by weight), based on the total weight of the antioxidant composition. In some embodiments, such green tea catechins are present in the antioxidant composition in a total concentration of from 0.2 to 10% (by weight), based on the total weight of the antioxidant composition. In some embodiments, such green tea catechins are present in the antioxidant composition in a total concentration of from 0.5 to 10% (by weight), based on the total weight of the antioxidant composition. In some embodiments, such green tea catechins are present in the antioxidant composition in a total concentration of from 1 to 10% (by weight), based on the total weight of the antioxidant composition. In some embodiments, such green tea catechins are present in the antioxidant composition in a total concentration of from 1.5 to 7% (by weight), based on the total weight of the antioxidant composition. In some embodiments, such green tea catechins are present in the antioxidant composition in a total concentration of from 2 to 7% (by weight), based on the total weight of the antioxidant composition. In some embodiments, such green tea catechins are

present in the antioxidant composition in a total concentration of from 4 to 7% (by weight), based on the total weight of the antioxidant composition.

[42] In some embodiments, the GTE is a dried solid (*e.g.*, powder, granule, etc.). In some embodiments, the GTE is in the form of a liquid (*e.g.*, in an aqueous medium). In some
5 embodiments, the GTE is in the form of a suspension.

Citrus Fiber

[43] Another component of the antioxidant of this specification is a citrus fiber ("CF"). A CF is a fiber obtained from a fruit of the citrus family.

10 [44] The citrus family is a large and diverse family of flowering plants. Citrus fruit is considered to be a berry characterized by a leathery peel and a fleshy interior containing multiple sections filled with juice-filled sacs. Common varieties of the citrus fruit include oranges, clementines, kumquats, tangerines, tangelos, satsumas, mandarins, grapefruits, citrons, pomelos, lemons, and limes. The citrus fruit may be early-season, mid-season or late-season
15 citrus fruit.

[45] In some embodiments, the antioxidant comprises CF extracted from an orange, tangerine, lime, lemon or grapefruit.

[46] In some embodiments, the antioxidant comprises CF extracted from an orange. In some embodiments, the CF in the antioxidant consists of orange fiber.

20 [47] In some embodiments, the antioxidant comprises CF extracted from a tangerine. In some embodiments, the CF in the antioxidant consists of tangerine fiber.

[48] In some embodiments, the antioxidant comprises CF extracted from a lemon. In some embodiments, the CF in the antioxidant consists of lemon fiber.

25 [49] In some embodiments, the antioxidant comprises CF extracted from a lime. In some embodiments, the CF in the antioxidant consists of lime fiber.

[50] In some embodiments, the antioxidant comprises CF extracted from a grapefruit. In some embodiments, the CF in the antioxidant consists of grapefruit fiber.

[51] In some embodiments, the CF in the antioxidant comprises fibers from two different types of citrus fruits. In some embodiments, the CF in the antioxidant consists of fibers
30 from two different types of citrus fruits. In some embodiments, the CF in the antioxidant comprises fibers from three different types of citrus fruits. In some embodiments, the CF in the antioxidant consists of fibers from three different types of citrus fruits. In some embodiments, the CF in the antioxidant comprises fibers from more than three different types of citrus fruits.

[52] In general, a CF is extracted from a source of the CF. In some embodiments, for example, a citrus fruit (*e.g.*, an orange) is picked and sent to a citrus processing center where it is squeezed to make orange juice. The remaining portion of the citrus fruit, which may include juice vesicles, rag (membrane and core) and peel, is then sent to a manufacturing facility to
5 extract CF. Many processes for conducting such an extraction are known in the art.

[53] In some embodiments, the CF is extracted from juice vesicles, rag, and/or peel of a citrus fruit. In some embodiments, the CF is extracted from juice vesicles, rag or peel of a citrus fruit. In some embodiments, the CF is extracted from juice vesicles, rag, and peel of a citrus fruit.

10 [54] In some embodiments, the CF is extracted from citrus vesicles. The term "citrus vesicle" refers to the cellulosic material contained in the inner, juice-containing portion of citrus fruit. Citrus vesicles are sometimes also referred to in the art as coarse pulp, floaters, citrus cells, floating pulp or pulp.

15 [55] In some embodiments, the CF is additionally or alternatively extracted from the peel of the fruit.

[56] In some embodiments, the CF is provided as dried citrus(*e.g.*, orange) peel. In some embodiments, the CF is alternatively or additionally provided as dried citrus (*e.g.*, orange) pulp.

[57] In some embodiments, the CF is provided as citrus(*e.g.*, orange) flour.

20 [58] In some embodiments, the CF in the antioxidant is a dried CF (*e.g.*, a powder, granule, etc.). In some embodiments, the CF in the antioxidant is in the form of a suspension.

[59] A variety of citrus fibers are commercially available. These include citrus fibers from, for example, Herbafood Ingredients GmbH (Werder, Germany) under the HERBACEL name; and Fiberstar, Inc. (River Falls, WI, USA) under the CITRI-FI name.

25 [60] In general, the amount of CF used in a process of this specification is an amount that provides a desired antioxidant effect, taking into account the amount of GTE used as well. In some embodiments, the amount of CF used is an amount that has a sufficient amount of polyphenols (particularly polyphenols that are water-insoluble) attached to the fibers to provide the desired antioxidant effect, taking into account the amount of the GTE used as well. In some
30 embodiments, the amount of CF used is an amount that also does not negatively impact the desired flavor. In some embodiments, the amount of CF used is an amount that also imparts a pleasant or otherwise desired flavor.

[61] In some embodiments, the antioxidant composition of this specification comprises the CF at a concentration of at least 10% (by weight), based on the total weight of the

[62] In some embodiments, the antioxidant composition comprises the CF at a concentration of no greater than 99% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a concentration of no greater than 95% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a concentration of no greater than 90% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a concentration of no greater than 85% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a

concentration of no greater than 80% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a concentration of no greater than 75% (by weight), based on the total weight of the antioxidant composition.

5 **[63]** In some embodiments, the antioxidant composition comprises the CF at a concentration of from 40 to 99% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a concentration of from 40 to 95% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a
10 concentration of from 40 to 90% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a concentration of from 40 to 85% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a
15 concentration of from 40 to 80% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a concentration of from 40 to 75% (by weight), based on the total weight of the antioxidant composition.

[64] In some embodiments, the antioxidant composition comprises the CF at a concentration of from 50 to 99% (by weight), based on the total weight of the antioxidant
20 composition. In some embodiments, the antioxidant composition comprises the CF at a concentration of from 50 to 95% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a concentration of from 50 to 90% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a
25 concentration of from 50 to 85% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a concentration of from 50 to 80% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a concentration of from 50 to 75% (by weight), based on the total weight of the antioxidant
30 composition.

[65] In some embodiments, the antioxidant composition comprises the CF at a concentration of from 60 to 99% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a concentration of from 60 to 95% (by weight), based on the total weight of the antioxidant

composition. In some embodiments, the antioxidant composition comprises the CF at a concentration of from 60 to 90% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a concentration of from 60 to 85% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a concentration of from 60 to 80% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a concentration of from 60 to 75% (by weight), based on the total weight of the antioxidant composition.

[66] In some embodiments, the antioxidant composition comprises the CF at a concentration of from 70 to 99% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a concentration of from 70 to 95% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a concentration of from 70 to 90% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a concentration of from 70 to 85% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a concentration of from 70 to 80% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a concentration of from 70 to 75% (by weight), based on the total weight of the antioxidant composition.

[67] In some embodiments, the antioxidant composition comprises the CF at a concentration of from 80 to 99% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a concentration of from 80 to 95% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a concentration of from 80 to 90% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises the CF at a concentration of from 80 to 85% (by weight), based on the total weight of the antioxidant composition.

Antioxidant Composition

[68] The composition used in a process of this specification comprises an antioxidant composition. In general, the amounts of GTE and CF present in the antioxidant composition are amounts that, together, provide a desired antioxidant effect. In some embodiments, such amounts also are amounts that, together, have little or no negative impact flavor. In some embodiments, the amounts are amounts that impart a pleasant or otherwise desired flavor.

[69] In some embodiments, the GTE/CF weight ratio in the antioxidant composition is from 1:30 to 30:1.

[70] In some embodiments, the GTE/CF weight ratio in the antioxidant composition is from 1:25 to 10:1. In some embodiments, the GTE/CF weight ratio is from 1:15 to 1:1. In some embodiments, the GTE/CF weight ratio is from 1:15 to 1:3. In some embodiments, the GTE/CF weight ratio is from 1:15 to 1:4. In some embodiments, the GTE/CF weight ratio is from 1:15 to 1:5. In some embodiments, the GTE/CF weight ratio is from 1:15 to 1:7. In some embodiments, the GTE/CF weight ratio is from 1:12 to 1:3. In some embodiments, the GTE/CF weight ratio is from 1:12 to 1:4. In some embodiments, the GTE/CF weight ratio is from 1:12 to 1:5. In some embodiments, the GTE/CF weight ratio is from 1:12 to 1:7. In some embodiments, the GTE/CF weight ratio is from 1:10 to 1:7. In some embodiments, the GTE/CF weight ratio is from 1:10 to 1:8. In some embodiments, the GTE/CF weight ratio is about 1:9.

[71] In some embodiments, the GTE/CF weight ratio in the antioxidant composition is from 1:10 to 25:1. In some embodiments, the GTE/CF weight ratio is from 1:10 to 15:1. In some embodiments, the GTE/CF weight ratio is from 1:5 to 15:1. In some embodiments, the GTE/CF weight ratio is from 1:1 to 15:1. In some embodiments, the GTE/CF weight ratio is from 2:1 to 15:1. In some embodiments, the GTE/CF weight ratio is from 3:1 to 15:1. In some embodiments, the GTE/CF weight ratio is from 5:1 to 15:1. In some embodiments, the GTE/CF weight ratio is from 7:1 to 15:1. In some embodiments, the GTE/CF weight ratio is from 1:1 to 12:1. In some embodiments, the GTE/CF weight ratio is from 2:1 to 12:1. In some embodiments, the GTE/CF weight ratio is from 3:1 to 12:1. In some embodiments, the GTE/CF weight ratio is from 5:1 to 12:1. In some embodiments, the GTE/CF weight ratio is from 7:1 to 12:1. In some embodiments, the GTE/CF weight ratio is from 1:1 to 10:1. In some embodiments, the GTE/CF weight ratio is from 2:1 to 10:1. In some embodiments, the GTE/CF weight ratio is from 3:1 to 10:1. In some embodiments, the GTE/CF weight ratio is from 1:1 to 5:1. In some embodiments, the GTE/CF weight ratio is from 2:1 to 5:1. In some embodiments, the GTE/CF weight ratio is from 3:1 to 5:1. In some embodiments, the GTE/CF weight ratio is from 1:1 to 4:1. In some embodiments, the GTE/CF weight ratio is from 2:1 to 4:1.

[72] In some embodiments, the antioxidant composition comprises both: (i) a GTE concentration falling within a GTE concentration range discussed in this specification, and (ii) a GTE/CF weight ratio falling within a GTE/CF weight ratio range discussed in this specification. In some embodiments, the antioxidant composition comprises both: (i) a CF concentration
5 falling within a CF concentration range discussed in this specification, and (ii) a GTE/CF weight ratio falling within a GTE/CF weight ratio range discussed in this specification. In some embodiments, the antioxidant composition comprises all the following: (i) a GTE concentration falling within a GTE concentration range discussed in this specification, (ii) a CF concentration falling within a CF concentration range discussed in this specification, and (iii) a GTE/CF weight
10 ratio falling within a GTE/CF weight ratio range discussed in this specification.

[73] In some embodiments, the antioxidant composition comprises dried citrus (*e.g.*, orange) peel. In some embodiments, the antioxidant composition alternatively or additionally comprises dried citrus (*e.g.*, orange) pulp. In some embodiments, the antioxidant composition comprises citrus (*e.g.*, orange) flour.

15 [74] In some embodiments, the antioxidant composition is a flavorant composition suitable for addition to a foodstuff.

[75] In some embodiments, the antioxidant composition is in the form of a dried solid. The antioxidant composition can, however, be in other forms), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a
20 foodstuff in an amount to provide the CF in an amount of, for example, a suspension.

Application

[76] In some embodiments, an antioxidant composition is contacted with a foodstuff to reduce oxidation of the foodstuff. In some embodiments, the foodstuff comprises an
25 emulsion. In some such embodiments, the emulsion comprises an oil-in-water emulsion. In other embodiments, the emulsion comprises a water-in-oil emulsion. In some embodiments, the emulsion comprises a double emulsion. A "double emulsion" is an emulsion in an emulsion. In some embodiments, the double emulsion is a water-in-oil-in-water emulsion. In some
embodiments, the double emulsion is an oil-in-water-in-oil emulsion.

30 [77] Many foodstuffs may be preserved by an antioxidant composition or process of this specification. Typical foodstuffs are raw meat, cooked meat, raw poultry products, cooked poultry products, raw seafood products, cooked seafood products, cereals, cereal bars, ready to eat meals, pasta sauces, pasteurised soups, mayonnaise, salad dressings, oil-in-water emulsions, margarines, low fat spreads, water-in-oil emulsions, dairy products, cheese spreads, processed

cheese, dairy desserts, flavored milks, cream, fermented milk products, cheese, butter, condensed milk products, ice cream mixes, soya products, pasteurised liquid egg, bakery products, confectionery products, fruit products, and foods with fat-based or water-containing fillings.

5 **[78]** In some embodiments, the foodstuff comprises a meat, cereal, cereal bar, pasta sauce, pasteurised soup, butter, margarine, low-fat spread, dairy product, soya products, pasteurised liquid egg, bakery product, confectionery product, fruit product, or food with a fat-based or water-containing filling.

10 **[79]** In some embodiments, the foodstuff comprises a poultry meat product, seafood product, butter, cheese spread, processed cheese, dairy dessert, flavored milk, cream, fermented milk product, condensed milk product, ice cream mix.

15 **[80]** In some embodiments, the foodstuff is mayonnaise, a salad dressing, an oil-in-water emulsion, a water-in-oil emulsion or a double emulsion. In some embodiments, the foodstuff is an oil-in-water emulsion. In some embodiments, the foodstuff is a water-in-oil emulsion. In some embodiments, the foodstuff is a water-in-oil-in-water emulsion. In some
embodiments, the foodstuff is an oil-in-water-in-oil emulsion. In some embodiments, the foodstuff is mayonnaise. In some embodiments, the foodstuff is a salad dressing. In some
embodiments, the foodstuff is a beverage.

20 **[81]** In some embodiments, the foodstuff comprises an animal feed), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the CF in an amount of a feed for a companion animal or livestock animal.

25 **[82]** In some embodiments, the antioxidant is dosed to a foodstuff in an amount of no greater than 1% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant is dosed to a foodstuff in an amount of no greater than 0.9% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant is dosed to a foodstuff in an amount of no greater than 0.8% (by weight), based on the weight of the foodstuff. In some
embodiments, the antioxidant is dosed to a foodstuff in an amount of no greater than 0.7% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant is dosed to
30 a foodstuff in an amount of no greater than 0.6% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant is dosed to a foodstuff in an amount of no greater than 0.6% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant is dosed to a foodstuff in an amount of no greater than 0.4% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant is dosed to a foodstuff in an

amount of no greater than 0.3% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant is dosed to a foodstuff in an amount of no greater than 0.3% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant is dosed to a foodstuff in an amount of no greater than 0.1% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant is dosed to a foodstuff in an amount of no greater than 0.09% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant is dosed to a foodstuff in an amount of no greater than 0.08% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant is dosed to a foodstuff in an amount of no greater than 0.07% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant is dosed to a foodstuff in an amount of no greater than 0.06% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant is dosed to a foodstuff in an amount of no greater than 0.05% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant is dosed to a foodstuff in an amount of no greater than 0.04% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant is dosed to a foodstuff in an amount of no greater than 0.03% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant is dosed to a foodstuff in an amount of no greater than 0.02% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant is dosed to a foodstuff in an amount of no greater than 0.01% (by weight), based on the weight of the foodstuff.

[83] In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.01 to 1% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.01 to 0.9% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.01 to 0.8% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.01 to 0.7% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.01 to 0.6% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.01 to 0.5% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.01 to 0.4% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.01 to 0.3% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a

foodstuff in an amount of from 0.01 to 0.2% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.01 to 0.1% (by weight), based on the weight of the foodstuff.

[84] In some embodiments, an antioxidant of this specification is dosed to a foodstuff
5 in an amount of from 0.02% (by weight) to 1% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.02 to 0.9% (by weight), based on the weight of the foodstuff. In some
10 embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.02 to 0.8% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.02 to 0.7% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this
15 specification is dosed to a foodstuff in an amount of from 0.02 to 0.6% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.02 to 0.5% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount
20 of from 0.02 to 0.4% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.02 to 0.3% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.02 to 0.2% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.02 to 0.1% (by weight), based on the weight of the foodstuff.

[85] In some embodiments, an antioxidant of this specification is dosed to a foodstuff
in an amount of from 0.03% (by weight) to 1% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an
25 amount of from 0.03 to 0.9% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.03 to 0.8% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.03 to 0.7% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this
30 specification is dosed to a foodstuff in an amount of from 0.03 to 0.6% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.03 to 0.5% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.03 to 0.4% (by weight), based on the weight of the foodstuff. In some embodiments,

5 foodstuff in an amount of from 0.03 to 0.1% (by weight), based on the weight of the foodstuff.

embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.04 to 0.8% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.04 to 0.7% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.04 to 0.6% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.04 to 0.5% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.04 to 0.4% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.04 to 0.3% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.04 to 0.2% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.04 to 0.1% (by weight), based on the weight of the foodstuff.

in an amount of from 0.05% (by weight) to 1% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.05 to 0.9% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.05 to 0.8% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.05 to 0.7% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.05 to 0.6% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.05 to 0.5% (by weight), based on the weight of the foodstuff.

5 specification is dosed to a foodstuff in an amount of from 0.05 to 0.2% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.05 to 0.1% (by weight), based on the weight of the foodstuff.

foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.06 to 0.9% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.06 to 0.8% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.06 to 0.7% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.06 to 0.6% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.06 to 0.5% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.06 to 0.4% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.06 to 0.3% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.06 to 0.2% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.06 to 0.1% (by weight), based on the weight of the foodstuff.

embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.07 to 0.8% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.07 to 0.7% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.07 to 0.6% (by weight), based on the

an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.07 to 0.3% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.07 to 0.2% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.07 to 0.1% (by weight), based on the weight of the foodstuff.

0 [90] In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.08% (by weight) to 1% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.08 to 0.9% (by weight), based on the weight of the foodstuff. In some
5 embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.08 to 0.8% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.08 to 0.7% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.08 to 0.6% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a
10 foodstuff in an amount of from 0.08 to 0.5% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.08 to 0.4% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.08 to 0.3% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this
15 specification is dosed to a foodstuff in an amount of from 0.08 to 0.2% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.08 to 0.1% (by weight), based on the weight of the foodstuff.

[91] In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.09% (by weight) to 1% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.09 to 0.9% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.09 to 0.8% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.09 to 0.7% (by

weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.09 to 0.6% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.09 to 0.5% (by weight), based on the weight of the foodstuff.

5 In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.09 to 0.4% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.09 to 0.3% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.09 to 0.2% (by weight), based on the weight of the foodstuff. In some embodiments, an antioxidant of this specification is dosed to a foodstuff in an amount of from 0.09 to 0.1% (by weight), based on the weight of the foodstuff.

[92] In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of no greater than 0.5% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of no greater than 0.4% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of no greater than 0.3% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of no greater than 0.2% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of no greater than 0.1% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of no greater than 0.07% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of no greater than 0.05% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of no greater than 0.04% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of no greater than 0.03% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of no greater than 0.02%

(by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of no greater than 0.025% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of no greater than 0.015% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of no greater than 0.01% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of no greater than 0.0075% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of no greater than 0.005% (by weight), based on the weight of the foodstuff.

[93] In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of from 0.5 to 1% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of from 0.4 to 1% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of from 0.3 to 1% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of from 0.2 to 1% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of from 0.01 to 1% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of from 0.07 to 1% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of from 0.05 to 1% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of from 0.04 to 1% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of from 0.03 to 1% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this

specification is dosed to a foodstuff in an amount to provide the GTE in an amount of from 0.02 to 1% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of from 0.01 to 1% (by weight), based on the weight of the foodstuff. In some
5 embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of from 0.005 to 1% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the GTE in an amount of from 0.005 to 0.05% (by weight), based on the weight of the foodstuff.

10 [94] In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the CF in an amount of no greater than 1% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the CF in an amount of no greater than 0.8% (by weight), based on the weight of the foodstuff. In some embodiments, the
15 antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the CF in an amount of no greater than 0.6% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the CF in an amount of no greater than 0.4% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification
20 is dosed to a foodstuff in an amount to provide the CF in an amount of no greater than 0.2% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the CF in an amount of no greater than 0.08% (by weight), based on the weight of the foodstuff. In some
25 embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the CF in an amount of no greater than 0.05% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the CF in an amount of no greater than 0.04% (by weight), based on the weight of the foodstuff. In some
30 embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the CF in an amount of no greater than 0.03% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the CF in an amount of no greater than 0.02% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the CF in an amount of no greater than 0.025%

(by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the CF in an amount of no greater than 0.015% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the CF in an amount of no greater than 0.01% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the CF in an amount of no greater than 0.0075% (by weight), based on the weight of the foodstuff.

[95] In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the CF in an amount of from 0.005 to 1% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the CF in an amount of from 0.5 to 1% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the CF in an amount of from 0.4 to 1% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the CF in an amount of from 0.3 to 1% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the CF in an amount of from 0.2 to 1% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the CF in an amount of from 0.1 to 1% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the CF in an amount of from 0.07 to 1% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the CF in an amount of from 0.05 to 1% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the CF in an amount of from 0.04 to 1% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the CF in an amount of from 0.03 to 1% (by weight), based on the weight of the foodstuff. In some embodiments, the antioxidant composition of this specification is dosed to a foodstuff in an amount to provide the CF in an amount of from 0.02 to 1% (by weight), based on the weight of the foodstuff.

Additional Components

[96] In some embodiments, the antioxidation composition of this specification consists of the GTE and CF.

5 [97] In other embodiments, the antioxidant composition of this specification comprises one or more additional components.

[98] In some embodiments, the antioxidant composition of this specification comprises no components other than the GTE and CF that materially affect the antioxidative properties of antioxidant composition.

10 [99] In some embodiments, the antioxidant composition comprises one or more carriers. In some embodiments, the carrier(s) is selected from propylene glycol, maltodextrin, sugar, salt, ethanol, water, protein, glycerol, medium chain triglyceride (MCT oil) and vegetable oil. In such embodiments, the GTE and CF may be blended with the carrier (or carriers) in a suitable manner. For example, the GTE and CF may be simply mixed with a suitable carrier (or carriers).

15 [100] In some embodiments, the antioxidant composition comprises a carrier(s) at a total concentration of from 1 to 40% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises a carrier(s) at a total concentration of from 2 to 35% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises a carrier(s) at a total
20 concentration of from 5 to 30% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises a carrier(s) at a total concentration of from 5 to 25% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises a carrier(s) at a total concentration of from 10 to 30% (by weight), based on the total weight of the antioxidant
25 composition. In some embodiments, the antioxidant composition comprises a carrier(s) at a total concentration of from 10 to 25% (by weight), based on the total weight of the antioxidant composition. In some embodiments, the antioxidant composition comprises a carrier(s) at a total concentration of from 15 to 25% (by weight), based on the total weight of the antioxidant composition.

30 [101] In some embodiments, the antioxidant composition comprises an emulsifier. In some such embodiments, the emulsifier is selected from polyoxyethylene sorbitan esters (polysorbates), polyoxyethylene stearate, mono- and diglycerides of fatty acids, mono- and diglycerides esters further esterified with a dibasic organic acid selected from acetic acid, lactic acid, citric acid and mono- and diacetyl tartaric acid or mixtures thereof, lecithin, polyglycerol

esters of fatty acids, polyglycerol polyricinoleate, sucrose esters of fatty acids, sucroglycerides, propylene glycol esters of fatty acids, sorbitan esters of fatty acids, sodium and calcium salt of stearyl-2-lactylate, sodium, potassium, calcium and magnesium salts of fatty acids and ammonium phosphatides.

5

Use of Separate Compositions

[102] Typically, the process discussed herein is more easily practiced by applying a single antioxidant composition comprising both the GTE and CF to a foodstuff to reduce oxidation. However, the process may alternatively be practiced by applying the GTE and CF as
10 separate compositions to a foodstuff to reduce oxidation of the foodstuff.

[103] In some such embodiments, the separate compositions are applied to the foodstuff at the same time. In other such embodiments, the separate compositions are alternatively or additionally applied separately to the foodstuff. Typically, any such separate applications are in close time proximity to each other.

15 [104] In some embodiments, two separate compositions are applied to the foodstuff, wherein at least one of the two compositions comprises GTE and at least the other composition comprises CF. In some embodiments, two separate compositions are applied to the foodstuff, wherein only one of the compositions comprises GTE and only the other composition comprises CF.

20 [105] In some embodiments, at least one of the separate compositions is a dry composition. In some embodiments, each of the separate compositions is a dry composition. In some embodiments, at least one of the separate compositions is a suspension. In some embodiments, each of the separate compositions is a suspension. In some embodiments, one of the separate compositions (*e.g.*, the composition comprising GTE) is a liquid.

25 [106] In general, the GTE and CF dosages and weight ratios discussed above for single antioxidation composition applications are equally applicable when the GTE and CF are applied to a foodstuff as separate compositions.

[107] In some embodiments, the separate compositions are marketed as a kit comprising the separate compositions and instructions for their use to reduce the oxidation of a
30 foodstuff.

EXAMPLES

[108] The following examples are merely illustrative, and not limiting to this specification in any way.

Example 1

Antioxidant efficacy evaluation

Materials used

5 [109] Ethylenediaminetetraacetic acid ("EDTA"): A chemical metal chelator used in various food applications for oxidation control.

 [110] GUARDIAN™ CHELOX L (DuPont, New Century, KS): A commercially available antioxidant product comprising a blend of rosemary extract and chamomile extract.

10 [111] Green tea extract: Obtained by a sequential solvent extraction process with hot water (at approximately 80°C) and then ethyl acetate (at room temperature) from green tea leaves (*Camellia sinensis*), followed by spray drying. This extract contained approximately 80% (by weight) catechins.

 [112] Citrus fiber: CITRI-FI 100M40 (>95% (±4%) passing through 200 mesh) (Fiberstar, Inc., River Falls, WI). A natural fiber extracted from orange pulp.

15

Methods

 [113] Use of a mixture of green tea [*Camellia sinensis*] extract ("GTE") and citrus fiber ("CF") was studied in mayonnaise. In this experiment, the GTE/CF blend was compared to a chemical antioxidant benchmark (EDTA) and a plant extract antioxidant benchmark (GUARDIAN™ CHELOX L).

20 [114] The mayonnaise was produced according to the formulation in **Table 1** and the procedure outlined below. All ingredients in the mayonnaise were food-grade quality. The antioxidant dosage was based on the total product mayonnaise weight. Specifically, the dosage of EDTA was 75 ppm (recommended and maximum allowed level by regulation); the dosage of GUARDIAN™ CHELOX L was 750 ppm (recommended level by the manufacturer, DuPont);
25 and the dosage of the GTE/CF blend (10/90 blending ratio) was 1500 ppm.

Table 1
Mayonnaise formulation (%)

Ingredient	Mayonnaise with no antioxidants (control)	Mayonnaise with EDTA	Mayonnaise with GUARDIAN™ CHELOX L	Mayonnaise with GTE + CF
Soybean Oil	70	70	70	70
Salt	1	1	1	1
Sucrose	1.6	1.6	1.6	1.6
Vinegar	4	4	4	4
Mustard powder	0.25	0.25	0.25	0.25
Egg yolk powder	3	3	3	3
EDTA	----	0.0075	----	----
Guardian® Chelox L	----	----	0.075	----
GTE/CF*	----	----	----	0.15
Water	20.15	20.1425	20.075	20
TOTAL	100	100	100	100

Procedure

5 [115] Water was added to a THERMOMIX™ TM5 blender (Vorwerk, Thousand Oaks, CA) with a butterfly attachment, followed by addition of sugar and the antioxidant. The contents were mixed at speed 2 for 2 min. The remaining ingredients, except the soybean oil and acids, were added and mixed for 1 min at speed 3. The soybean oil was then added slowly and mixed at speed 3.5 for 1.5 min, followed by addition of vinegar. The contents were emulsified under
10 high shear at speed 6 for 2 min, and pH was adjusted to 3.8-4.0 with lactic acid.

[116] The tested mayonnaise samples were stored at 37°C. The concentrations of peroxide and MDA were measured for each of the different formulations after 1, 2 and 4 weeks. These experiments were conducted in duplicate.

15 *Determination of peroxide value*

[117] Peroxide value was determined by ferric thiocyanate method according to IDF (International Dairy Federation) Standards 74A: 1991 with modifications. Briefly, 1.5 ml of isooctane/isopropanol (3/2) was added to 0.3g of mayonnaise sample and the content mixed by

shaking and vortexing. The mixture was then centrifuged at 3500 rpm for 5 min, and an aliquot (0.2 ml) of the supernatant was transferred to another tube, to which 2.8 ml of methanol/butanol (2/1) and 30 μ l of Fe^{2+} /thiocyanate reagent were added. The absorbance of the mixture was measured after exactly 20 min at 510 nm. Fe^{2+} /thiocyanate reagent was prepared by mixing equal volumes of ammonium thiocyanate (3.94M) and Fe^{2+} solution (freshly prepared by mixing 0.132M barium chloride and 0.144M ferrous sulfate at 1:1 followed by centrifugation). Peroxide value was calculated from a standard curve of cumene hydroperoxide.

Determination of MDA value by TBARS assay

[118] Secondary oxidation products (TBARS as MDA equivalent) were measured by a spectrophotometric method on the mayonnaise samples. Briefly, 1 g of the mayonnaise sample was added to a centrifuge tube containing 5 ml of TCA (trichloroacetic acid, 10%, w/v) and 5 ml of TBA reagent (0.02M, prepared by stirring under very low heat) and the content was mixed by vortexing for 1 min. The tube was centrifuged at 9000 rpm for 5 min, and supernatant decanted to another clean tube. The tube was heated in a water bath at 95°C for 45 min and then cooled down in an ice bath. The absorbance of the clear solution was measured at 532nm, and results were calculated from a standard curve of tetraethoxypropane.

Results

[119] The average values of peroxide (measured as meq/kg of mayonnaise) and MDA (measured as μ mol MDA eq./kg of mayonnaise) are shown in **Table 2** and **Table 3** below, and graphically in **Figure 1** and **Figure 2**.

Table 2

Peroxide values (meq/kg) of mayonnaise after 1, 2 and 4 weeks of storage at 37°C

	1 week	2 weeks	4 weeks
Control	9.40	25.47	44.33
EDTA	2.40	9.27	16.33
Chelox	5.23	18.26	40.09
GTE + CF	4.23	13.47	29.98

Table 3
TBARS values (μ mol MDA eq./Kg) of mayonnaise
after 1, 2 and 4 weeks of storage at 37°C

	1 week	2 weeks	4 weeks
Control	19.47	26.51	28.35
EDTA	5.17	5.99	7.86
Chelox	12.99	25.53	33.61
GTE + CF	11.85	17.27	25.34

5 **[120]** As can be seen, the control (without antioxidant) exhibited the highest degree of oxidation throughout the accelerated storage, as indicated by PV and TABRS. Addition of EDTA, Chelox and GTE/CF effectively reduced oxidation to various extents. While EDTA showed the strongest antioxidant efficacy, the GTE/CF blend was more effective than the GUARDIAN™ CHELOX L in reducing oxidation.

10

Example 2

Sensory evaluation

[121] A two-component mixture of green tea [*Camellia sinensis*] extract ("GTE") and citrus fiber ("CF") was investigated in mayonnaise for flavor contribution.

15 **[122]** The mayonnaise was produced according to the formulation in **Table 4** and the procedure outlined below. All ingredients in the mayonnaise were food-grade quality. The dosage was based on the total product mayonnaise weight. The dosages of GTE/CF blend (10/90 blending ratio) were 1500 ppm (low) and 3000 ppm (high).

Table 4
Mayonnaise formulation (%)

Ingredients (%)	Control	Low	High
Soybean Oil	70	70	70
Salt	1	1	1
Sucrose	1.6	1.6	1.6
GTE/CF	----	0.15	0.3
Vinegar 50 grain	4	4	4
Mustard powder	0.25	0.25	0.25
Egg Yolk Powder	3	3	3
Water	20.15	20	19.85
TOTAL	100	100	100

Procedure

5 **[123]** Water was added to a THERMOMIX™ TM5 blender with a butterfly attachment, followed by addition of sugar and the antioxidant. The contentd were mixed at speed 2 for 2 min. The remaining ingredients, except oil and acids, were added and mixed for 1 min at speed 3. Oil was then added slowly and mixed at speed 3.5 for 1.5 min, followed by addition of vinegar. The contents were emulsified under high shear at speed 6 for 2 min, and pH was
10 adjusted to 3.8-4.0 with lactic acid.

Results

15 **[124]** The freshly prepared mayonnaise samples were allowed to set in a cooler for 1 day before they were tasted by 6 untrained panelists. The flavors of mayonnaise containing a low (1500 ppm) and a high (3000 ppm) level of GTE/CF were evaluated and compared with that of the control base formula with no GTE/CF added. Four out of six panelists detected the flavor difference between the control and the samples containing GTE/CF at both levels. One panelist ranked the one with 1500 ppm of GTE/CF the most-liked flavor, one panelist reported sharp tartness with GTE/CF at both levels, one panelist described a stronger flavor with the GTE/CF
20 containing samples, and one panelist described the GTE/CF samples different from control.

* * * * *

[125] The words "comprise", "comprises" and "comprising" are to be interpreted inclusively rather than exclusively. This interpretation is intended to be the same as the interpretation that these words are given under United States patent law at the time of this filing.

5 [126] The singular forms "a" and "an" are intended to include plural referents unless the context dictates otherwise. Thus, for example, a reference to the presence of "an excipient" does not exclude the presence of multiple excipients unless the context dictates otherwise.

CLAIMS

We claim:

- 5 1. A process for reducing oxidation of a foodstuff, wherein the process comprises contacting the foodstuff with:
a green tea [*Camellia sinensis*] extract, and
a citrus fiber.
- 10 2. A process according to claim 1, wherein the process comprises contacting the foodstuff with an antioxidant composition comprising:
a green tea [*Camellia sinensis*] extract, and
a citrus fiber.
- 15 3. A process according to any one of the preceding claims, wherein oxidation of the foodstuff is delayed.
4. A process according to any one of the preceding claims, wherein oxidation of the foodstuff is prevented.
- 20 5. A process according to any one of the preceding claims, wherein the citrus fiber is a dried citrus fiber.
6. A process according to any one of the preceding claims, wherein the citrus fiber
25 comprises citrus fiber from a peel of a citrus fruit.
7. A process according to any one of the preceding claims, wherein the citrus fiber comprises citrus fiber from a tangerine, lemon, lime or grapefruit.
- 30 8. A process according to any one of the preceding claims, wherein the citrus fiber comprises citrus fiber from an orange.
9. A process according to any one of the preceding claims, wherein the citrus fiber consists of citrus fiber from an orange.

10. A process according to any one of the preceding claims, wherein the foodstuff comprises a meat, cereal, cereal bar, pasta sauce, pasteurised soup, butter, margarine, low-fat spread, dairy product, soya products, pasteurised liquid egg, bakery product, confectionery product, fruit product, or food with a fat-based or water-containing filling.

11. A process according to any to claim 10, wherein the foodstuff comprises a poultry meat product, seafood product, butter, cheese spread, processed cheese, dairy dessert, flavored milk, cream, fermented milk product, condensed milk product, ice cream mix.

12. A process according to any one of claims 1-9, wherein the foodstuff comprises mayonnaise.

13. A process according to any one of the preceding claims, wherein the foodstuff comprises an emulsion.

14. A process according to claim 13, wherein the emulsion is an oil-in water emulsion.

15. A process according to claim 13, wherein the emulsion is an water-in-oil emulsion.

16. A process according to claim 13, wherein the emulsion is a double emulsion.

17. A process according to any one of claims 1-9 and 13-16, wherein the foodstuff comprises a salad dressing.

18. A process according to any one of claims 2-17, wherein the antioxidant composition further comprises a carrier.

19. A process according to claim 18, wherein the carrier is maltodextrin.

20. A process according to any one of claims 2-19, wherein the green tea [*Camellia sinensis*] extract is present in the antioxidant composition at a concentration of no greater than 20% (by weight), based on the total weight of the antioxidant composition.

21. A process according to any one of claims 2-20, wherein the green tea [*Camellia sinensis*] extract is present in the antioxidant composition at a concentration of at least 10% (by weight), based on the total weight of the antioxidant composition.

5 22. A process according to any one of claims 2-21, wherein the green tea [*Camellia sinensis*] extract is present in the antioxidant composition at a concentration of from 5 to 10% (by weight), based on the total weight of the antioxidant composition.

10 23. A process according to any one of claims 2-22, wherein the citrus fiber is present in the antioxidant composition at a concentration of no greater than 95% (by weight), based on the total weight of the antioxidant composition.

15 24. A process according to any one of claims 2-23, wherein the citrus fiber is present in the antioxidant composition at a concentration of at least 80% (by weight), based on the total weight of the antioxidant composition.

20 25. A process according to any one of claims 2-24, wherein the citrus fiber is present in the antioxidant composition at a concentration of from 50 to 95% (by weight), based on the total weight of the antioxidant composition.

26. A process according to any one of claims 2-25, wherein the weight ratio of the antioxidant composition to the foodstuff is from 0.0001 to 0.01.

25 27. A process according to any one of the preceding claims, wherein the foodstuff is contacted with dried citrus peel.

28. A process according to any one of the preceding claims, wherein the foodstuff is contacted with dried citrus pulp.

30 29. A process according to any one of the preceding claims, wherein the foodstuff is contacted with citrus flour.

30. An antioxidant composition for use in reducing oxidation of a foodstuff, wherein the antioxidant composition comprises:

a green tea [*Camellia sinensis*] extract, and
a citrus fiber.

5 31. An antioxidant composition according to claim 30, wherein the antioxidant composition comprises dried citrus peel.

32. An antioxidant composition according to claim 30 or claim 31, wherein the antioxidant composition comprises dried citrus pulp.

10 33. An antioxidant composition according to any one of claims 30-32, wherein the antioxidant composition comprises citrus flour.

34. An antioxidant composition according to any one of claims 30-33, wherein the foodstuff comprises an emulsion.

15 35. Use of a composition according to any one of claims 30-34 for reducing oxidation of a foodstuff.

20 36. A foodstuff, wherein the foodstuff is protected from oxidation by a method of any one of claims 1-26.

37. A preserved foodstuff composition, wherein:
the preserved foodstuff composition comprises:
a foodstuff, and
25 an antioxidant composition; and
the antioxidant composition comprises:
a green tea [*Camellia sinensis*] extract, and
a citrus fiber.

30 38. A preserved foodstuff composition according to claim 37, wherein the foodstuff comprises an emulsion.

39. A preserved foodstuff composition according to claim 38, wherein the emulsion is an oil-in water emulsion.

40. A preserved foodstuff composition according to claim 38, wherein the emulsion is an water-in-oil emulsion.

5 41. A preserved foodstuff composition according to claim 38, wherein the emulsion is a double emulsion.

42. A preserved foodstuff composition according to any one of claims 37-41, wherein the foodstuff comprises a salad dressing.

10

43. A preserved foodstuff composition according to claim 37, wherein the foodstuff comprises mayonnaise.

15 44. A preserved foodstuff composition according to claim 37, wherein the foodstuff comprises a meat, cereal, cereal bar, pasta sauce, pasteurised soup, butter, margarine, low-fat spread, dairy product, soya products, pasteurised liquid egg, bakery product, confectionery product, fruit product, or food with a fat-based or water-containing filling.

20 45. A preserved foodstuff composition according to claim 37, wherein the foodstuff comprises a poultry meat product, seafood product, butter, cheese spread, processed cheese, dairy dessert, flavored milk, cream, fermented milk product, condensed milk product, ice cream mix.

25 46. A kit, wherein the kit comprises:
a green tea [*Camellia sinensis*] extract,
a citrus fiber, and
instructions for contacting the green tea [*Camellia sinensis*] extract with a foodstuff to reduce oxidation of the foodstuff.

1/2

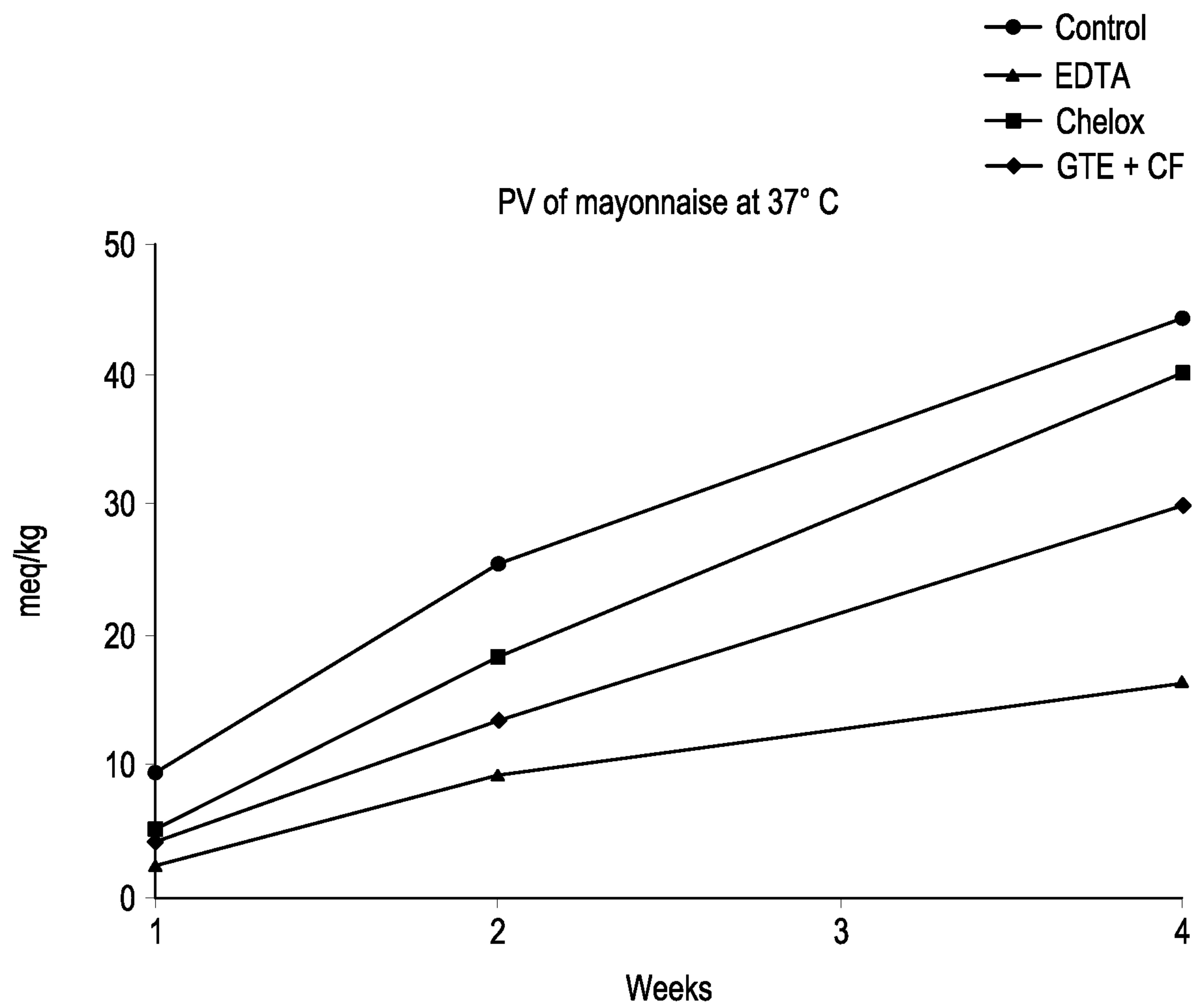


FIG. 1

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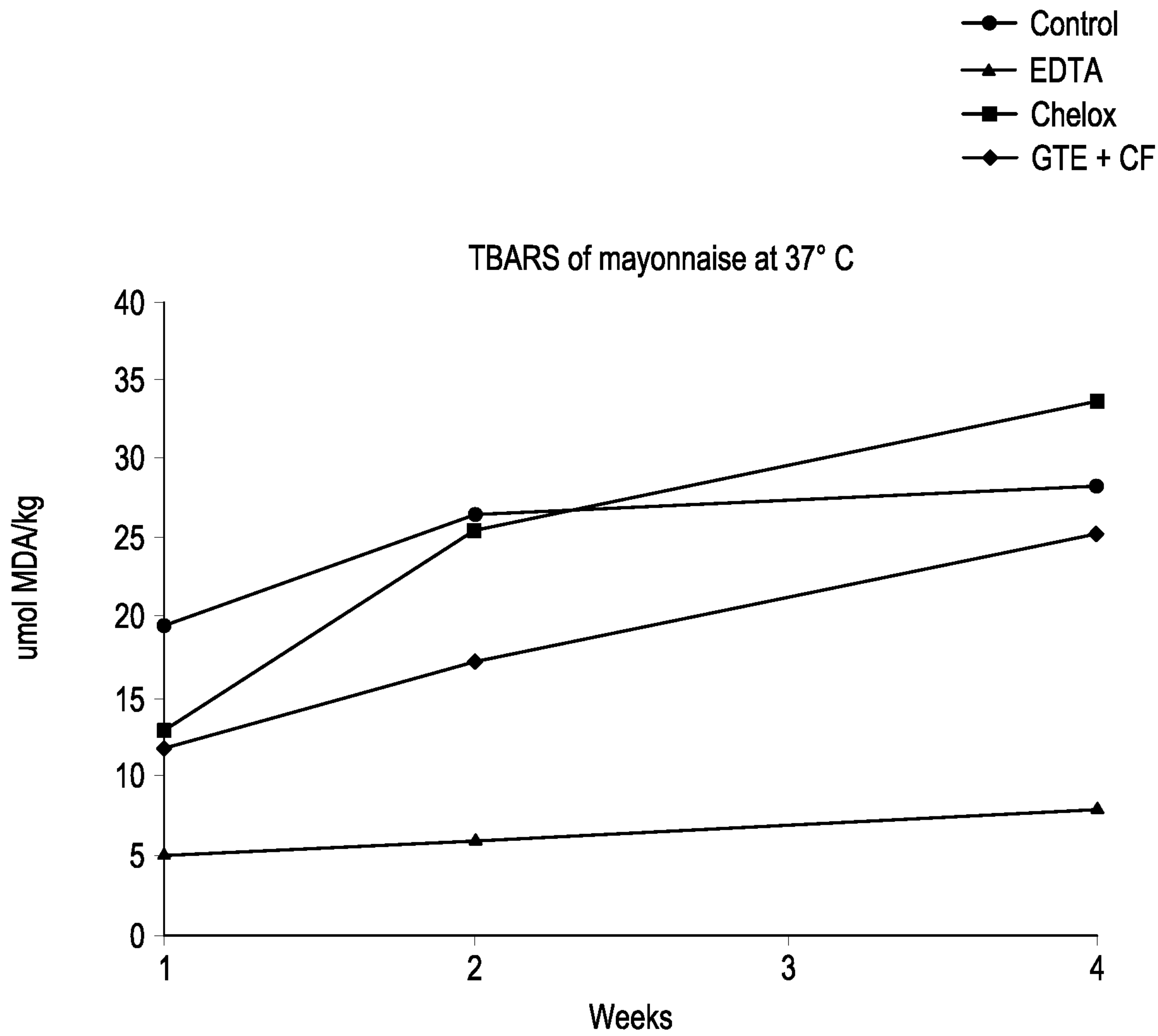


FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2020/060131

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A23L 3/3517; A23B 4/20; A23B 5/14; A23B 9/26; A23L 13/40; A23L 27/12; C11B 5/00 (2020.01)

CPC - A23L 3/3517; A23L 13/428; A23L 19/07; A23L 27/13; A23L 33/105; A23V 2200/02; A23V 2250/214; C11B 5/0035 (2020.08)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

see Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

see Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

see Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2016/0058061 A1 (KEMIN INDUSTRIES INC) 03 March 2016 (03.03.2016) entire document	1-3, 30-32, 37-46
Y →	IBRAHIM et al., Application of lemon and orange peels in meat products: Quality and safety, International Journal of Current Microbiology and Applied Sciences, Vol. 7, No. 4, 10 April 2018 [retrieved on 11 January 2021]. Retrieved from the Internet: <URL: https://www.ijcmas.com/7-4-2018/Hayam%20M.%20Ibrahim,%20et%20al.pdf >. Pgs. 2703-2723	1-3, 30-32, 37-46
Y	US 2009/0220665 A1 (VANHEMELRIJCK et al) 03 September 2009 (03.09.2009) entire document	32
Y	US 2008/0206427 A1 (TAKI et al) 28 August 2008 (28.08.2008) entire document	41
Y	US 2017/0354159 A1 (DUPONT NUTRITION BIOSCIENCES APS) 14 December 2017 (14.12.2017) entire document	46
A --	CN 107028107 A (GUANGXI NORMAL UNIVERSITY) 11 August 2017 (11.08.2017) see machine translation	1-3, 30-32, 37-46
A	US 2016/0235081 A1 (PRONATURAL BRANDS LLC) 18 August 2016 (18.08.2016) entire document	1-3, 30-32, 37-46

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"D" document cited by the applicant in the international application

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

15 January 2021

Date of mailing of the international search report

08 FEB 2021

Name and mailing address of the ISA/US

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P.O. Box 1450, Alexandria, VA 22313-1450

Facsimile No. 571-273-8300

Authorized officer

Blaine R. Copenheaver

Telephone No. PCT Helpdesk: 571-272-4300

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2020/060131

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☒ Claims Nos.: 4-29, 33-36
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.