

SAVORY TASTE ENHANCEMENT VIA TRANSMEMBRANE REGION BINDING**CROSS-REFERENCE TO RELATED APPLICATIONS**

The present application claims the benefit of priority of U.S. Provisional Application No. 63/056,389, filed July 24, 2020, which is hereby incorporated by reference as though set
5 forth herein in its entirety.

TECHNICAL FIELD

The present disclosure generally provides methods for imparting or enhancing an umami taste of a flavored article by introducing a compound that modulates a transmembrane (TM) region of a T1R taste receptor, such as the TM region of a T1R1 taste receptor. In
10 some other aspects, the disclosure provides methods of identifying compounds that modulate a transmembrane (TM) region of a T1R taste receptor, and which thereby imparts or enhances an umami taste in a flavored article. In some other aspects, the disclosure provides compounds that modulate a transmembrane (TM) region of a T1R taste receptor, and their use in food or beverage products, in some cases, in combination with other compounds
15 known to impart or enhance umami taste, such as glutamates, aspartates, and purinic ribonucleotides, such as inosine monophosphate (IMP) and guanosine monophosphate (GMP). In some aspects, the inclusion of such TM-region modulators in flavored products may allow one to reduce or eliminate the concentration of glutamate and aspartate in certain food and beverage products.

20 DESCRIPTION OF RELATED ART

The taste system provides sensory information about the chemical composition of the external world. Taste transduction is one of the more sophisticated forms of chemically triggered sensation in animals. Signaling of taste is found throughout the animal kingdom, from simple metazoans to the most complex of vertebrates. Mammals are believed to have
25 five basic taste modalities: sweet, bitter, sour, salty, and umami/kokumi.

Umami is the taste most commonly associated with the savory taste of monosodium glutamate (MSG), meat products, cheeses, tomatoes, mushrooms, soy sauce, fish sauce, miso, and the like. Mammals generally perceive umami to be a pleasurable sensation. Kokumi is a related taste commonly associated with the taste of fermented products, soy sauce, fish sauce,
30 and shrimp paste. Many of these typical sources of umami and kokumi taste are high in glutamic acid and salt, or rely on animal products.

Excessive sodium intake can cause a number of health-related problems. One such problem is hypertension. Hypertension is a condition in which the pressure of the blood against artery walls is high enough that it may eventually cause heart disease and other health problems. Excessive sodium intake also adversely affect the balance of water and minerals in the body. For example, excessive sodium intake can cause calcium loss, which can lead to osteoporosis and other problems. Excessive consumption of food products containing glutamic acid can also have certain adverse health effects, as glutamic acid interferes with the functioning of neurotransmitters. Thus, it is generally desirable to reduce the consumption of sodium and glutamic acid. Further, there is increased consumer demand for food and beverage products that do not contain animal-derived ingredients, such as animal-derived fats, meat products, or dairy products.

Enhancement of umami or kokumi provides an alternative approach to partially or completely replacing ingredients that are traditionally used to impart umami or kokumi taste. In some cases, researchers have discovered compounds that impart or enhance an umami taste, which allows one to reduce or eliminate glutamates, aspartates, or meat and cheese products. But such compounds can introduce off tastes that leave the food product tasting less desirable than a comparable product with higher concentrations of glutamate, salt, or animal products. Thus, there is a continuing need to discover compounds that have improved ability to mimic the natural tastes of foods that traditionally exhibit a pleasurable umami taste.

SUMMARY

The present disclosure relates to the discovery that compounds that modulate the transmembrane (TM) region of the T1R1 taste receptor can enhance the activity of compounds that traditionally modulate the venus flytrap (VFT) region of the T1R1 taste receptor. This has led to the development of screening assays that can be used to identify and select compound that exhibit such umami-enhancing behavior.

In a first aspect, the disclosure provides methods of identifying compounds that enhance umami taste, the method comprising: (a1) introducing a test compound to a first taste receptor, wherein the first taste receptor is a polypeptide that comprises a polypeptide sequence of SEQ ID NO: 2, a functional fragment thereof, or a polypeptide sequence whose sequence is at least 90% equivalent to either of the foregoing; (a2) measuring a first response of the first taste receptor protein to the test compound by comparing an activity of the first taste receptor protein in the presence and the absence of the test compound; (b1) introducing

the test compound to a second taste receptor comprising a first subunit and a second subunit, wherein the first subunit is a polypeptide that comprises a polypeptide sequence of SEQ ID NO: 1, a functional fragment thereof, or a polypeptide sequence whose sequence is at least 90% equivalent to either of the foregoing, and wherein the second subunit is a polypeptide that comprises a polypeptide sequence of SEQ ID NO.: 3, a functional fragment thereof, or a polypeptide sequence whose sequence is at least 90% equivalent to either of the foregoing, or the second subunit is a polypeptide that comprises a polypeptide sequence of SEQ ID NO.: 4, a functional fragment thereof, or a polypeptide sequence whose sequence is at least 90% equivalent to either of the foregoing; and (b2) measuring a second response of the second taste receptor to the test compound by comparing an activity of the second taste receptor protein in the presence and the absence of the test compound. In some embodiments, the methods further comprise: identifying an active test compound that enhances umami taste based on the measured first response and the measured second response; and, optionally, selecting the active test compound as a compound that enhances umami taste.

In a second aspect, the disclosure provides uses of an identified or selected active test compounds of any embodiments of the first aspect to enhance the umami taste of an ingestible composition.

In a third aspect, the disclosure provides methods of enhancing an umami taste of an ingestible composition, the method comprising introducing to an ingestible composition an identified or selected active test compounds of any embodiments of the first aspect.

In a fourth aspect, the disclosure provides ingestible compositions comprising an identified or selected active test compounds of any embodiments of the first aspect. In some embodiments, the ingestible composition is a non-naturally or a naturally occurring composition.

In a fifth aspect, the disclosure provides flavored products comprising an ingestible composition of the fourth aspect. In some embodiments, the flavored products are food products or beverage products, such as savory foods (e.g., chips, crisps, etc.), beverages, soups, cheeses, snack foods, and any low-sodium foods.

Further aspects, and embodiments thereof, are set forth below in the Detailed Description, the Drawings, the Abstract, and the Claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The following drawings are provided for purposes of illustrating various embodiments of the compositions and methods disclosed herein. The drawings are provided for illustrative

purposes only, and are not intended to describe any preferred compositions or preferred methods, or to serve as a source of any limitations on the scope of the claimed inventions.

FIG. 1 shows the activity of S807 with respect to the transmembrane domain (TMD) of the T1R1 taste receptor protein based on the assay of Zhang et al.

5 FIG. 2 shows protein binding activation curves for S807 and S807 in the presence of MSG for the T1R1 and T1R3 taste receptor proteins.

FIG. 3 shows the percentage of maximum activity for S807 alone and in combination with various umami compounds, including monosodium glutamate (MSG) and inosine 5'-monophosphate (IMP).

10 **DETAILED DESCRIPTION**

The following Detailed Description sets forth various aspects and embodiments provided herein. The description is to be read from the perspective of the person of ordinary skill in the relevant art. Therefore, information that is well known to such ordinarily skilled artisans is not necessarily included.

15 Definitions

The following terms and phrases have the meanings indicated below, unless otherwise provided herein. This disclosure may employ other terms and phrases not expressly defined herein. Such other terms and phrases have the meanings that they would possess within the context of this disclosure to those of ordinary skill in the art. In some instances, a term or
20 phrase may be defined in the singular or plural. In such instances, it is understood that any term in the singular may include its plural counterpart and vice versa, unless expressly indicated to the contrary.

A “umami compound” refers to a compound that elicits a detectable umami flavor in a subject, e.g., a compound that activates a T1R1 taste receptor in vitro in the presence of a
25 T1R3 taste receptor. An “umami enhancer” refers to a compound that agonizes the activation of one or more T1R1 taste receptors in vitro by an umami compound.

A “functional fragment” refers to a portion of a polypeptide sequence to which the umami compound or the test compound binds. Polypeptide sequences often contain certain amino acids that do not actively participate in binding, but which may serve other purposes.
30 In some instances, these non-functioning parts of the polypeptide sequence can be removed or partially replaced, while leaving the functional portion of the sequence intact. These

modified proteins are said to comprise a functional fragment of the original polypeptide sequence.

As used herein, the singular forms “a,” “an,” and “the” include plural referents unless the context clearly dictates otherwise. For example, reference to “a substituent” encompasses
5 a single substituent as well as two or more substituents, and the like.

As used herein, “for example,” “for instance,” “such as,” or “including” are meant to introduce examples that further clarify more general subject matter. Unless otherwise expressly indicated, such examples are provided only as an aid for understanding
10 embodiments illustrated in the present disclosure, and are not meant to be limiting in any fashion. Nor do these phrases indicate any kind of preference for the disclosed embodiment.

As used herein, “comprise” or “comprises” or “comprising” or “comprised of” refer to groups that are open, meaning that the group can include additional members in addition to those expressly recited. For example, the phrase, “comprises A” means that A must be present, but that other members can be present too. The terms “include,” “have,” and
15 “composed of” and their grammatical variants have the same meaning. In contrast, “consist of” or “consists of” or “consisting of” refer to groups that are closed. For example, the phrase “consists of A” means that A and only A is present.

As used herein, “optionally” means that the subsequently described event(s) may or may not occur. In some embodiments, the optional event does not occur. In some other
20 embodiments, the optional event does occur one or more times.

As used herein, “or” is to be given its broadest reasonable interpretation, and is not to be limited to an either/or construction. Thus, the phrase “comprising A or B” means that A can be present and not B, or that B is present and not A, or that A and B are both present. Further, if A, for example, defines a class that can have multiple members, e.g., A₁ and A₂,
25 then one or more members of the class can be present concurrently.

Other terms are defined in other portions of this description, even though not included in this subsection.

Polypeptide Sequences Activated by Umami Compounds

The present disclosure provides certain polypeptide sequences that are useful in the
30 simulating in vitro the response that certain human umami taste receptors would exhibit towards such compounds when ingested orally.

In some embodiments, the disclosure provides a polypeptide sequence of SEQ ID NO: 1, or a functional fragment thereof, or a polypeptide sequence whose sequence is at least

90% equivalent, or at least 95% equivalent, or at least 97% equivalent, to either of the foregoing. The polypeptide sequence corresponding to SEQ ID NO: 1 is set forth among the sequence listings filed herewith and incorporated by reference. For purposes of clarity and to avoid any confusion, the polypeptide sequence corresponding to SEQ ID NO: 1, starting with its N-terminus, is: MLLCTARLVGLQLLISCCWAFACHSTESSPDFTLPGDYLLAGLFP
 5 LHSGLQVRRPEVTLCDRSCSFNEHGYPHLFQAMRLGVEEINNSTALLPNITLGYQL
 YDVCSDSANVYATLRVLSLPGQHHLQGDLLHYSPTVLAVIGPDSTNRAATTAALL
 SPFLVPMISYAASSETLSVKRQYPSFLRTIPNDKYQVETMVLLQKFGWTWISLVGSS
 DDYGQLGVQALENQATGQGICIAFKDIMPFSAQVGDERMQCLMRHLAQAGATVVV
 10 VFSSRQLARVFFESVVLTNLTGKVWVASEAWALSRHITGVPGIQRIGMVLGVAIQKR
 AVPGLKAFEEAYARADKKAPRPCHKGSWCSSNQLCRECQAFMAHTMPKLKAFSMS
 SAYNAYRAVYAVAHGLHQLLGACSGACSRGRVYPWQLLEQIHKVHFLHKTVAFA
 NDNRDPLSSYNIIAWDWNPKWTFTVLGSSTWSPVQLNINETKIQWHGKDNQVPKS
 VCSSDCLEGHQRVVTGFHHCCFECVPCGAGTFLNKSDLYRCQPCGKEEWAPEGSQT
 15 CFPRTVVFLALREHTSWVLLAANTLLLLLLGTAGLFAWHLDTPVVRSAAGRLCFL
 MLGSLAAGSGSLYGFFGEPTRPACLLRQALFALGFTIFLSCLTVRSFQLIIIFKSTKVP
 TFYHAWVQNHGAGLFVMISSAAQLLICLTWLVVWTPLPAREYQRFPHLVMLECTET
 NSLGFILAFLYNGLLSISAFACSYLGKDLPENYNEAKCVTFSLLENFVSWIAFFTASV
 YDGKYLPAANMMAGLSSLSSGFGGYFLPKCYVILCRPDLNSTEHFQASIQDYTRRCG
 20 ST, using the standard single-letter codes representing amino acids. The sequence listing directed to this sequence is hereby incorporated by reference.

In some embodiments, the disclosure provides a polypeptide sequence of SEQ ID NO: 2, or a functional fragment thereof, or a polypeptide sequence whose sequence is at least 90% equivalent, or at least 95% equivalent, or at least 97% equivalent, to either of the
 25 foregoing. The polypeptide sequence corresponding to SEQ ID NO: 2 is set forth among the sequence listings filed herewith and incorporated by reference. For purposes of clarity and to avoid any confusion, the polypeptide sequence corresponding to SEQ ID NO: 2, starting with its N-terminus, is: MLLCTARLVGLQLLISCCWAFACHSTESSPDFTLPGDYLLAG
 LFPFPRTVVFLALREHTSWVLLAANTLLLLLLGTAGLFAWHLDTPVVRSAAGRLCF
 30 LMLGSLAAGSGSLYGFFGEPTRPACLLRQALFALGFTIFLSCLTVRSFQLIIIFKSTKV
 PTFYHAWVQNHGAGLFVMISSAAQLLICLTWLVVWTPLPAREYQRFPHLVMLECTE
 TNSLGFILAFLYNGLLSISAFACSYLGKDLPENYNEAKCVTFSLLENFVSWIAFFTAS
 VYDGKYLPAANMMAGLSSLSSGFGGYFLPKCYVILCRPDLNSTEHFQASIQDYTRRC

GSTEQKLISEEDL, using the standard single-letter amino acid codes. The sequence listing directed to this sequence is hereby incorporated by reference.

In some other embodiments, the disclosure provides a polypeptide sequence of SEQ ID NO: 3, or a functional fragment thereof, or a polypeptide sequence whose sequence is at least 90% equivalent, or at least 95% equivalent, or at least 97% equivalent, to either of the foregoing. The polypeptide sequence corresponding to SEQ ID NO: 3 is set forth among the sequence listings filed herewith and incorporated by reference. For purposes of clarity and to avoid any confusion, the polypeptide sequence corresponding to SEQ ID NO: 3, starting with its N-terminus, is: MPGLAILGLSLAAFLELGMGSSLCLSQQFKAQGDYILGGLFPLGTT
 5 EEATLNQRTQPNGILCTRFSPGLFLAMAMKMAVEEINNGSALLPGLRLGYDLFDTC
 SEPVVTMKPSLMFMAKVGSQSIAAYCNYTQYQPRVLAVIGPHSSELALITGKFFSFLL
 MPQVSYSASMDRLSDRETFPSFFRTVPSDRVQLQAVVTLLQNFSWNWVAALGSDDD
 YGREGLSIFSGLANSRGICIAHEGLVPQHDTSGQQLGKVVDVLRQVNQSKVQVVVLF
 ASARAVYSLFSYSILHDLSPKVWVASESWLTSDLVMTLPNIARVGTVLGFLQRGALL
 15 PEFSHYVETRLAALADPTFCASLKAELDLEERVMGPRCSQCDYIMLQNLSSGLMQNL
 SAGQLHHQIFATYAAVYSVAQALHNTLQCNVSHCHTSEPVPWQLENMYNMSFR
 ARDLTLQFDAKGSVDMEYDLKMWWVQSPTPVLHTVGTENGTLQLQHSMYWPNG
 QVPVSQCSRQCKDGQVRRVKGFHSCCYDCVDCCKAGSYRKHPDDFTCTPCGKDQWS
 PEKSTTCLPRRPKFLEWGEPVLLLLLLLLSLALGLVLAALGLFVHHRDSPLVQASGGP
 20 LACFGLVCLGLVCLSVLLFPGQPSPARCLAQQPLSHLPLTGCLSTLFLQAAEIFVESEL
 PLSWADRLSGCLRGPAWLVLVLLAMLVEVALCTWYLVAFPPEVVDWHMLPTEA
 LVHCRTRSWVSFGLAHATNATLAFLCFLGTFLVRSQPGRYNRARGLTFAMLAYFIW
 VSFVPLLANVQVVLRAVQMGALLLCVLGILAAFHLPRLCYLLMRQPGLNTPPEFFLGG
 GPGDAQGQNDGNTGNQKHE, using the standard single-letter amino acid codes. The
 25 sequence listing directed to this sequence is hereby incorporated by reference.

In some other embodiments, the disclosure provides a polypeptide sequence of SEQ ID NO: 4, or a functional fragment thereof, or a polypeptide sequence whose sequence is at least 90% equivalent, or at least 95% equivalent, or at least 97% equivalent, to either of the foregoing. The polypeptide sequence corresponding to SEQ ID NO: 4 is set forth among the sequence listings filed herewith and incorporated by reference. For purposes of clarity and to avoid any confusion, the polypeptide sequence corresponding to SEQ ID NO: 3, starting with its N-terminus, is: MLGPAVLGLSLWALLHPGTGAPLCLSQQLRMKGDYVLGGLFPLG
 30 EAAEAGLRSRTRPSPVCTRFSSNGLLWALAMKMAVEEINNKSDDLPLGLRLGYDLFD
 TCSEPVVAMKPSLMFLAKAGSRDIAAYCNYTQYQPRVLAVIGPHSSELAMVTGKFFS

FFLMPQVSYGASMELLSARETFPSFFRTVPSDRVQLTAAAEELLQEFQWNWVAALGS
 DDEYGRQGLSIFSALAAARGICIAHEGLVPLPRADDSRLGKVQDVLHQVNQSSVQVV
 LLFASVHAAHALFNYSISSRLSPKVWVASEAWLTSDLVMGLPGMAQMGTVLGFLQR
 GAQLHEFPQYVKTHLALATDPAFCSALGEREQGLEEDVVGQRCPQCDCITLQNVSA
 5 GLNHHQTFSVYAAVYSVAQALHNTLQCNASGCPAQDPVKPWQLLENMYNLTfHVG
 GLPLRFDSSGNVDMEYDLKLWVWQGSVPRLHDVGRFNGSLRTERLKIRWHTSDNQ
 KPVSRCRQCQEGQVRRVKGFHSCCYDCVDCEAGSYRQNPDDIACFTCGQDEWSPE
 RSTRCFRRRSRFLAWGEPVLLLLLLLLSLALGLVLAALGLFVHHRDSPLVQASGGPL
 ACFGLVCLGLVCLSVLLFPGQPSPARCLAQQPLSHLPLTGCLSTLFLQAAEIFVESELP
 10 LSWADRLSGCLRGPAWLVLMLVEVALCTWYLVAFPPEVVTDWMLPTEAL
 VHCRTRSWVSFGLAHATNATLAFLCFLGTFLVRSQPGRYNRARGLTFAMLAYFITW
 VSFVPLLANVQVVLRAVQMGALLLCVLGILAAFHLPRCYLLMRQPGLNTPEFFLGG
 GPGDAQGQNDGNTGNQKHE, using the standard single-letter amino acid codes. The
 sequence listing directed to this sequence is hereby incorporated by reference.

15 The polypeptide sequences of the foregoing aspects and embodiments can be present
 in any suitable composition. In some embodiments, one or more polypeptide sequences of
 the foregoing aspects and embodiments is present in a non-naturally occurring composition,
 such as an in vitro assay. In some further such embodiments, the polypeptide sequences of
 the foregoing aspects and embodiments are expressed on the surface of cells, such as on the
 20 cells of a eukaryotic cell line.

Screening Methods

In certain aspects, the disclosure provides methods of identifying compounds that
 enhance umami taste, the method comprising: (a1) introducing a test compound to a first
 taste receptor, wherein the first taste receptor is a polypeptide that comprises a polypeptide
 25 sequence of SEQ ID NO: 2, a functional fragment thereof, or a polypeptide sequence whose
 sequence is at least 90% equivalent to either of the foregoing; (a2) measuring a first response
 of the first taste receptor to the test compound by comparing an activity of the first taste
 receptor in the presence and the absence of the test compound; (b1) introducing the test
 compound to a second taste receptor comprises a first subunit and a second subunit, wherein
 30 the first subunit is a polypeptide that comprises a polypeptide sequence of SEQ ID NO: 1 and
 wherein the second subunit is a polypeptide that comprises a polypeptide or SEQ ID NO: 3, a
 functional fragment thereof, or a polypeptide sequence whose sequence is at least 90%
 equivalent to either of the foregoing, or the second subunit is a polypeptide that comprises a

polypeptide or SEQ ID NO: 4; and (b2) measuring a second response of the second taste receptor protein to the test compound by comparing an activity of the second taste receptor protein in the presence and the absence of the test compound.. In some embodiments, the methods further comprise: identifying an active test compound that enhances umami taste
5 based on the measured first response and the measured second response; and, optionally, selecting the active test compound as a compound that enhances umami taste.

In some embodiments thereof, the initial introducing step (a1) comprises introducing a test compound to a taste receptor, wherein the taste receptor is a polypeptide that comprises a polypeptide sequence of SEQ ID NO: 2, or a functional fragment thereof, or a polypeptide
10 sequence whose sequence is at least 90% equivalent, or at least 95% equivalent, or at least 97% equivalent, to either of the foregoing. In some further embodiments, the taste receptor protein is a polypeptide that comprises: a polypeptide sequence of SEQ ID NO: 2, or a polypeptide sequence whose sequence is at least 90% equivalent, or at least 95% equivalent, or at least 97% equivalent, thereto.

15 In some embodiments thereof, the second introducing step comprises introducing a test compound to a taste receptor, wherein the taste receptor comprises a first subunit and a second subunit. The first subunit is a polypeptide that comprises a polypeptide sequence of SEQ ID NO: 1, or a functional fragment thereof, or a polypeptide sequence whose sequence is at least 90% equivalent, or at least 95% equivalent, or at least 97% equivalent, to either of
20 the foregoing. In some further embodiments, the taste receptor protein is a polypeptide that comprises: a polypeptide sequence of SEQ ID NO: 1, or a polypeptide sequence whose sequence is at least 90% equivalent, or at least 95% equivalent, or at least 97% equivalent, thereto. The polypeptide of SEQ ID NO: 1 can be referred to in certain instances as a “T1R1” taste receptor.

25 The second subunit is a polypeptide that comprises a polypeptide sequence of SEQ ID NO: 3, or a functional fragment thereof, or a polypeptide sequence whose sequence is at least 90% equivalent, or at least 95% equivalent, or at least 97% equivalent, to either of the foregoing, or the second subunit is a polypeptide that comprises a polypeptide sequence of SEQ ID NO: 4, or a functional fragment thereof, or a polypeptide sequence whose sequence
30 is at least 90% equivalent, or at least 95% equivalent, or at least 97% equivalent, to either of the foregoing. The polypeptides of SEQ ID NO: 3 or SEQ ID NO.: 4 can be referred to in certain instances as a “T1R3” taste receptors.

In some embodiments, the second subunit is a polypeptide that comprises a polypeptide sequence of SEQ ID NO: 3, or a functional fragment thereof, or a polypeptide

sequence whose sequence is at least 90% equivalent, or at least 95% equivalent, or at least 97% equivalent, to either of the foregoing. In some other embodiments, the second subunit is a polypeptide that comprises a polypeptide sequence of SEQ ID NO: 4, or a functional fragment thereof, or a polypeptide sequence whose sequence is at least 90% equivalent, or at least 95% equivalent, or at least 97% equivalent, to either of the foregoing. The polypeptides of SEQ ID NO: 3 or SEQ ID NO: 4 can be referred to in certain instances as a “T1R3” taste receptors.

The initial introducing steps (a1) and (b1) can be carried out in any suitable way. For example, in some non-limiting instances, when introducing the test compound to taste receptors, the introducing can be carried out in a single cell-based assay. But in some other non-limiting instances, when introducing the test compound to two or more different taste receptor proteins, the introducing can be carried out in a two or more cell-based assays, such as one separate assay for each taste receptor protein. Any suitable assay can be used, according to the knowledge of those skilled in the art.

In some instances, it can be desirable to measure the activity of the test compound in the presence of one or more additional compounds that have binding affinity towards the T1R1 taste receptor, the T1R3 taste receptor, or both. In this way, one can determine whether the test compound enhances (agonizes) or blocks (antagonizes) the binding of the one or more additional compounds. In some embodiments, the one or more additional compounds comprise an umami compound. Thus, in some embodiments, the introducing steps (a1 and b1) comprises introducing the test compound to the first taste receptor protein (or, in certain embodiments, to the third taste receptor protein too) in the presence of an umami compound, such as a compound that imparts or enhances umami taste.

In such embodiments, any suitable umami compounds can be used. Non-limiting examples include: L-glutamic acid; L-glutamates, such as monosodium glutamate (MSG), potassium glutamate, and calcium glutamate; L-aspartic acid; L-aspartates, such as sodium aspartate or potassium aspartate; and 5'-ribonucleotides, such as purinic ribonucleotides like guanosine 5'-monophosphate (GMP) and inosine 5'-monophosphate (IMP).

In general, the two sets of introducing and measuring steps are carried out in separate assays, and the responses are measured separately. Even so, the two sets of assays can be carried out at any given time relative to each other, and in any given order relative to each other. In some other embodiments, it may be desirable to carry out the two sets of introducing and measuring in the same assay. In such cases, the measured response for modulating the first taste receptor protein would be distinguishable from the response for

modulating the second taste receptor protein, such that the two responses are distinguishable from each other.

The foregoing embodiments involve measuring a response of the first and second taste receptor proteins to the test compound. This measuring can be carried out by any suitable means. For example, in some embodiments, each taste receptor protein is expressed on the surface of a cell, and compositions are screened against the cells expressing a taste receptor protein in a standard cellular assay. Measuring the binding can be carried out by any suitable means typically used in determining protein binding in cellular assays. Suitable methods include, but are not limited to, use of fluorescent dyes, a calcium indicator protein, a fluorescent cAMP indicator, and the like. Activity of the test compound is determined by its ability to agonize binding of the umami taste compound to one or more of the taste receptor proteins.

In some further embodiments of any of the foregoing embodiments, the methods further comprise identifying an active test compound that imparts or enhances umami taste based on the measured response. According to the foregoing embodiments, the identified active test compound is one that modulates both the first and second taste receptor proteins or agonizes the modulation by an umami compound of the first or second taste receptor proteins.

In some embodiments of any of the foregoing embodiments, the test compound is determined to be an active compound because it modulates the first taste receptor protein and the second taste receptor protein, for example, because it induces a response of both taste receptor proteins having an EC₅₀ of no more than 1 mM, or no more than 500 μ M, or no more than 250 μ M, or no more than 100 μ M.

In some embodiments of any of the foregoing embodiments, the test compound is determined to be an active compound because it modulates the activity of the umami compound to the first taste receptor protein and modulates the second taste receptor protein, for example, because it induces a response of both taste receptor proteins having an EC₅₀ of no more than 1 mM, or no more than 500 μ M, or no more than 250 μ M, or no more than 100 μ M.

In some further embodiments, the methods further comprise selecting the active test compound as a compound that imparts or enhances umami taste. The selecting can be carried out by any suitable means once the active test compounds are identified.

The test compound can be any suitable compound that is amenable for use in cellular screening assays. For example, in some embodiments, the test compound is an organic compound. In some embodiments, the test compound is a naturally occurring compound or a

glycosylated derivative thereof. In some other embodiments, the test compound is a non-naturally occurring compound. In some embodiments, the active compound is *N*-(heptan-4-yl)-benzo[*d*][1,3]dioxole-5-carboxamide.

Uses and Methods

5 In other aspects, the disclosure provides uses of any identified or selected active compounds of the foregoing aspects, including any embodiments or combination of
embodiments thereof, as set forth above. In certain related aspects, the disclosure provides
uses of any identified or selected active compounds of the foregoing aspects, including any
embodiments or combination of embodiments thereof, as set forth above, to impart an umami
10 taste or enhance an umami taste of an ingestible composition.

 The disclosure also provides methods that correspond to each of the foregoing uses.
Thus, in certain related aspects, the disclosure provides methods of imparting an umami taste
or enhancing an umami taste of an ingestible composition, comprising introducing an amount
(such as an umami-imparting amount or an umami enhancing amount) of any identified or
15 selected active compounds of foregoing aspects, including any embodiments or combination
of embodiments thereof, as set forth above, to the ingestible composition.

 The foregoing uses and methods generally involve the use of the identified or selected
active compounds in a composition containing one or more additional ingredients. For
example, in at least one aspect, the disclosure provides compositions comprising any
20 identified or selected active compounds of the foregoing aspects, including any embodiments
or combination of embodiments thereof, as set forth above, wherein the identified or selected
active compounds make up at least 50% by weight of the compositions on a dry weight basis
(e.g., based on the total weight of the composition excluding the weight of any liquid carrier).
In a related aspect, the disclosure provides solid-state compositions comprising any identified
25 or selected active compounds of the foregoing aspects, including any embodiments or
combination of embodiments thereof, as set forth above, wherein the identified or selected
active compounds make up at least 50% by weight of the solid-state compositions, based on
the total weight of composition. In another related aspect, the disclosure provides ingestible
compositions comprising identified or selected active compounds of the foregoing aspects,
30 including any embodiments or combination of embodiments thereof, as set forth above,
wherein the concentration of the identified or selected active compounds in the ingestible
compositions is no more than 200 ppm. In another related aspect, the disclosure provides
ingestible compositions comprising any identified or selected active compounds of the

foregoing aspects, including any embodiments or combination of embodiments thereof, as set forth above, wherein the ingestible compositions comprise no more than 1000 ppm, or no more than 900 ppm, or no more than 800 ppm, or no more than 700 ppm, or no more than 600 ppm, or no more than 500 ppm, or no more than 400 ppm, or no more than 300 ppm, or
5 no more than 200 ppm, or no more than 100 ppm, or no more than 50 ppm, of steviol glycosides (including rebaudioside A). In another related aspect, the disclosure provides ingestible compositions comprising any identified or selected active compounds of the foregoing aspects, including any embodiments or combination of embodiments thereof, as set forth above, wherein the ingestible compositions comprise a caloric sweetener, such as
10 sucrose, fructose, xylitol, erythritol, or combinations thereof. In another related aspect, the disclosure provides a concentrated sweetening composition comprising any flavor-modifying compounds of the foregoing aspects, including any embodiments or combination of embodiments thereof, as set forth above, and a sweetener.

In certain embodiments of any aspects and embodiments set forth herein that refer to
15 an ingestible composition, the ingestible composition is a non-naturally-occurring product, such as a composition specifically manufactured for the production of a flavored product, such as food or beverage product.

In certain aspects, the disclosure provides ingestible compositions comprising one or more umami compounds. In such embodiments, any suitable umami compounds can be used.
20 Non-limiting examples include: L-glutamic acid; L-glutamates, such as monosodium glutamate (MSG), potassium glutamate, and calcium glutamate; L-aspartic acid; L-aspartates, such as sodium aspartate or potassium aspartate; and 5'-ribonucleotides, such as purinic ribonucleotides like guanosine 5'-monophosphate (GMP) and inosine 5'-monophosphate (IMP).

25 In the preceding aspect, or in any other aspect that refers to an ingestible composition, the active compound can be present in the ingestible composition in any suitable concentration. For example, in some embodiments, the active compound is present in the ingestible composition at a concentration ranging from 1 ppm to 1000 ppm, or from 1 ppm to 900 ppm, or from 1 ppm to 800 ppm, or from 1 ppm to 700 ppm, or from 1 ppm to 600 ppm,
30 or from 1 ppm to 500 ppm, or from 1 ppm to 400 ppm, or from 1 ppm to 300 ppm, or from 1 ppm to 250 ppm, or from 1 ppm to 200 ppm, or from 1 ppm to 150 ppm, or from 1 ppm to 100 ppm, or from 1 ppm to 80 ppm, or from 1 ppm to 70 ppm, or from 1 ppm to 60 ppm, or from 1 ppm to 50 ppm, or from 1 ppm to 40 ppm, or from 1 ppm to 30 ppm, or from 1 ppm to 20 ppm, or from 5 ppm to 1000 ppm, or from 5 ppm to 900 ppm, or from 5 ppm to 800 ppm,

or from 5 ppm to 700 ppm, or from 5 ppm to 600 ppm, or from 5 ppm to 500 ppm, or from 5 ppm to 400 ppm, or from 5 ppm to 300 ppm, or from 5 ppm to 250 ppm, or from 5 ppm to 200 ppm, or from 5 ppm to 150 ppm, or from 5 ppm to 100 ppm, or from 5 ppm to 80 ppm, or from 5 ppm to 70 ppm, or from 5 ppm to 60 ppm, or from 5 ppm to 50 ppm, or from 5 ppm to 40 ppm, or from 5 ppm to 30 ppm, or from 5 ppm to 20 ppm.

In general, compounds as disclosed and described herein, individually or in combination, can be provided in a composition, such as an ingestible composition. In one embodiment, compounds as disclosed and described herein, individually or in combination, can impart a more umami-like temporal profile or flavor profile to a sweetener composition by combining one or more of the compounds as disclosed and described herein with one or more umami compounds, sweeteners, and the like. In another embodiment, compounds as disclosed and described herein, individually or in combination, can increase or enhance the sweet taste of a composition by contacting the composition thereof with the compounds as disclosed and described herein to form a modified composition.

Thus, in some embodiments, the compositions set forth in any of the foregoing aspects (including in any uses or methods), comprise an identified or selected active compound and an umami compound. In some embodiments, the composition further comprises a vehicle. In some embodiments, the vehicle is water. In some embodiments, the identified or selected active compound is present at a concentration at or below its sweetness recognition threshold.

In certain particular embodiments, the ingestible composition comprises monosodium glutamate and the active compound (or comestibly acceptable salts thereof). In some such embodiments, the introduction of the active compound (or comestibly acceptable salt thereof) permits one to use less monosodium glutamate (such as more than 10% less, more than 20% less, more than 30% less, more than 40% less, more than 50% less, more than 60% less, or more than 70% less, or more than 80% less, or more than 90% less) and still achieve a level of umami and/or kokumi characteristic of a comparable product that employs a higher concentration of monosodium glutamate. In some related embodiments, the use of the active compound, or its comestibly acceptable salts, permits the elimination of monosodium glutamate from the composition. In some embodiments, the concentration of the active compound, or its comestibly acceptable salts, is no more than 1000 ppm, or no more than 900 ppm, or no more than 800 ppm, or no more than 700 ppm, or no more than 600 ppm, or no more than 500 ppm, or no more than 400 ppm, or no more than 300 ppm, or no more than 200 ppm, or no more than 100 ppm, or no more than 50 ppm, or no more than 25 ppm, or no

more than 10 ppm. Such ingestible compositions can be in any suitable form. In some embodiments, the ingestible composition is a food product, such as any of those specifically listed below. In other embodiments, the ingestible composition is a beverage product, such as a soda, and the like.

- 5 In certain particular embodiments, the ingestible composition comprises fat, such as animal or vegetable fat, and the active compound (or comestibly acceptable salts thereof). In some such embodiments, the introduction of the active compound (or comestibly acceptable salt thereof) permits one to use less fat (such as more than 10% less, more than 20% less, more than 30% less, more than 40% less, more than 50% less, more than 60% less, or more than 70% less, or more than 80% less, or more than 90% less) and still achieve a level of umami and/or kokumi characteristic of a comparable product that employs a higher concentration of fat. In some related embodiments, the use of the active compound, or its comestibly acceptable salts, permits the elimination of fat from the composition. In some embodiments, the concentration of the active compound, or its comestibly acceptable salts, is 10 no more than 1000 ppm, or no more than 900 ppm, or no more than 800 ppm, or no more than 700 ppm, or no more than 600 ppm, or no more than 500 ppm, or no more than 400 ppm, or no more than 300 ppm, or no more than 200 ppm, or no more than 100 ppm, or no more than 50 ppm, or no more than 25 ppm, or no more than 10 ppm. Such ingestible compositions can be in any suitable form. In some embodiments, the ingestible composition 15 is a food product, such as any of those specifically listed below. In other embodiments, the ingestible composition is a beverage product, such as a soda, and the like. The fat can be any suitable fat, such as a fat derived from an animal or vegetable fat, including, but not limited to, milk fat (including fat in various cheeses), beef fat, pork fat, poultry fat, lamb fat, goat fat, fish oil, olive oil, canola oil, corn oil, safflower oil, nut oil, peanut oil, cashew oil, soybean 20 oil, palm oil, palm kernel oil, coconut oil, butter, and nut butters (such as peanut butter, cashew butter, almond butter, hazelnut butter, and the like).

- In certain particular embodiments, the ingestible composition comprises glutamate (including in its free acid form), and the active compound (or comestibly acceptable salts thereof). In some such embodiments, the introduction of the active compound (or comestibly 30 acceptable salt thereof) permits one to use less glutamate (such as more than 10% less, more than 20% less, more than 30% less, more than 40% less, more than 50% less, more than 60% less, or more than 70% less, or more than 80% less, or more than 90% less) and still achieve a level of umami and/or kokumi characteristic of a comparable product that employs a higher concentration of glutamate. In some related embodiments, the use of the active compound, or

its comestibly acceptable salts, permits the elimination of glutamate from the composition. In some embodiments, the concentration of the active compound, or its comestibly acceptable salts, is no more than 1000 ppm, or no more than 900 ppm, or no more than 800 ppm, or no more than 700 ppm, or no more than 600 ppm, or no more than 500 ppm, or no more than 400 ppm, or no more than 300 ppm, or no more than 200 ppm, or no more than 100 ppm, or no more than 50 ppm, or no more than 25 ppm, or no more than 10 ppm. Such ingestible compositions can be in any suitable form. In some embodiments, the ingestible composition is a food product, such as any of those specifically listed below. In other embodiments, the ingestible composition is a beverage product, such as a soda, and the like. The glutamate can be from any suitable source, such as monosodium glutamate (MSG), proteins containing glutamic acid (e.g., glutathione), potassium glutamate, calcium glutamate, and the like.

In certain particular embodiments, the ingestible composition comprises aspartate (including in its free acid form), and the active compound (or comestibly acceptable salts thereof). In some such embodiments, the introduction of the active compound (or comestibly acceptable salt thereof) permits one to use less aspartate (such as more than 10% less, more than 20% less, more than 30% less, more than 40% less, more than 50% less, more than 60% less, or more than 70% less, or more than 80% less, or more than 90% less) and still achieve a level of umami and/or kokumi characteristic of a comparable product that employs a higher concentration of aspartate. In some related embodiments, the use of the active compound, or its comestibly acceptable salts, permits the elimination of aspartate from the composition. In some embodiments, the concentration of the active compound, or its comestibly acceptable salts, is no more than 1000 ppm, or no more than 900 ppm, or no more than 800 ppm, or no more than 700 ppm, or no more than 600 ppm, or no more than 500 ppm, or no more than 400 ppm, or no more than 300 ppm, or no more than 200 ppm, or no more than 100 ppm, or no more than 50 ppm, or no more than 25 ppm, or no more than 10 ppm. Such ingestible compositions can be in any suitable form. In some embodiments, the ingestible composition is a food product, such as any of those specifically listed below. In other embodiments, the ingestible composition is a beverage product, such as a soda, and the like. The aspartate can be from any suitable source, such as proteins containing aspartic acid, and the like.

In certain particular embodiments, the ingestible composition comprises animal products, and the active compound (or comestibly acceptable salts thereof). In some such embodiments, the introduction of the active compound (or comestibly acceptable salt thereof) permits one to use less animal products (such as more than 10% less, more than 20% less, more than 30% less, more than 40% less, more than 50% less, more than 60% less, or more

than 70% less, or more than 80% less, or more than 90% less) and still achieve a level of umami and/or kokumi characteristic of a comparable product that employs a higher concentration of animal products. In some related embodiments, the use of the active compound, or its comestibly acceptable salts, permits the elimination of animal products from the composition. In some embodiments, the concentration of the active compound, or its comestibly acceptable salts, is no more than 1000 ppm, or no more than 900 ppm, or no more than 800 ppm, or no more than 700 ppm, or no more than 600 ppm, or no more than 500 ppm, or no more than 400 ppm, or no more than 300 ppm, or no more than 200 ppm, or no more than 100 ppm, or no more than 50 ppm, or no more than 25 ppm, or no more than 10 ppm. Such ingestible compositions can be in any suitable form. In some embodiments, the ingestible composition is a food product, such as any of those specifically listed below. In other embodiments, the ingestible composition is a beverage product, such as a soda, and the like. The animal products can be any suitable animal product, such as cheese, milk, meat broth (such as beef broth, pork broth, chicken broth, turkey broth, duck broth, lamb broth, goat broth, rabbit broth, and the like), eggs, bone broth, bone marrow, meat (such as beef, pork, chicken, lamb, goat, turkey, duck, rabbit, and the like), butter, and animal skin.

In certain particular embodiments, the ingestible composition comprises vegetable products, and the active compound (or comestibly acceptable salts thereof). In some such embodiments, the introduction of the active compound (or comestibly acceptable salt thereof) permits one to use less vegetable products (such as more than 10% less, more than 20% less, more than 30% less, more than 40% less, more than 50% less, more than 60% less, or more than 70% less, or more than 80% less, or more than 90% less) and still achieve a level of umami and/or kokumi characteristic of a comparable product that employs a higher concentration of vegetable products. In some related embodiments, the use of the active compound, or its comestibly acceptable salts, permits the elimination of vegetable products from the composition. In some embodiments, the concentration of the active compound, or its comestibly acceptable salts, is no more than 1000 ppm, or no more than 900 ppm, or no more than 800 ppm, or no more than 700 ppm, or no more than 600 ppm, or no more than 500 ppm, or no more than 400 ppm, or no more than 300 ppm, or no more than 200 ppm, or no more than 100 ppm, or no more than 50 ppm, or no more than 25 ppm, or no more than 10 ppm. Such ingestible compositions can be in any suitable form. In some embodiments, the ingestible composition is a food product, such as any of those specifically listed below. In other embodiments, the ingestible composition is a beverage product, such as a soda, and the

like. The vegetable products can be any suitable vegetable product, such as celery, celeriac, tomato, garlic, onion, leek, scallion, spices, and the like.

In certain particular embodiments, the ingestible composition comprises sodium (i.e., sodium cation), and the active compound (or comestibly acceptable salts thereof). In some such embodiments, the introduction of the active compound (or comestibly acceptable salt thereof) permits one to use less sodium (such as more than 10% less, more than 20% less, more than 30% less, more than 40% less, more than 50% less, more than 60% less, or more than 70% less, or more than 80% less, or more than 90% less) and still achieve a level of umami and/or kokumi characteristic of a comparable product that employs a higher concentration of sodium. In some related embodiments, the use of the active compound, or its comestibly acceptable salts, permits the elimination of sodium from the composition. In some embodiments, the concentration of the active compound, or its comestibly acceptable salts, is no more than 1000 ppm, or no more than 900 ppm, or no more than 800 ppm, or no more than 700 ppm, or no more than 600 ppm, or no more than 500 ppm, or no more than 400 ppm, or no more than 300 ppm, or no more than 200 ppm, or no more than 100 ppm, or no more than 50 ppm, or no more than 25 ppm, or no more than 10 ppm. Such ingestible compositions can be in any suitable form. In some embodiments, the ingestible composition is a food product, such as any of those specifically listed below. In other embodiments, the ingestible composition is a beverage product, such as a soda, and the like. The sodium can be any suitable animal product, such as table salt, sea salt, soy sauce, fish sauce, shrimp paste, butter, miso, and Worcestershire sauce.

In certain particular embodiments, the ingestible composition comprises alcohol, and the active compound (or comestibly acceptable salts thereof). In some such embodiments, the introduction of the active compound (or comestibly acceptable salt thereof) permits one to use less alcohol (such as more than 10% less, more than 20% less, more than 30% less, more than 40% less, more than 50% less, more than 60% less, or more than 70% less, or more than 80% less, or more than 90% less) and still achieve a level of umami and/or kokumi characteristic of a comparable product that employs a higher concentration of alcohol. In some related embodiments, the use of the active compound, or its comestibly acceptable salts, permits the elimination of alcohol from the composition. In some embodiments, the concentration of the active compound, or its comestibly acceptable salts, is no more than 1000 ppm, or no more than 900 ppm, or no more than 800 ppm, or no more than 700 ppm, or no more than 600 ppm, or no more than 500 ppm, or no more than 400 ppm, or no more than 300 ppm, or no more than 200 ppm, or no more than 100 ppm, or no more than 50 ppm, or no

more than 25 ppm, or no more than 10 ppm. Such ingestible compositions can be in any suitable form. In some embodiments, the ingestible composition is a food product, such as any of those specifically listed below. In other embodiments, the ingestible composition is a beverage product, such as a soda (such as a hard soda), and the like. The alcohol can present in any suitable form, such as alcohol formed from grains, cane sugar, fruits, and the like.

In some instances, one may be able to reduce the amount of sweetener in a product by enhancing the umami or kokumi taste.

In certain particular embodiments, the ingestible composition comprises sucrose and the active compound or any of its comestibly acceptable salts. In some such embodiments, the introduction of the active compound (or salt) permits one to use less sucrose (such as more than 10% less, more than 20% less, more than 30% less, more than 40% less, more than 50% less, more than 60% less, or more than 70% less) and still achieve a level of sweetness, umami, and/or kokumi characteristic of a comparable product that employs more sucrose. In some embodiments, the concentration of the active compound, or its comestibly acceptable salts, is no more than 1000 ppm, or no more than 900 ppm, or no more than 800 ppm, or no more than 700 ppm, or no more than 600 ppm, or no more than 500 ppm, or no more than 400 ppm, or no more than 300 ppm, or no more than 200 ppm, or no more than 100 ppm, or no more than 50 ppm, or no more than 25 ppm, or no more than 10 ppm. In some embodiments, the ingestible composition is a food product, such as any of those specifically listed below. In other embodiments, the ingestible composition is a beverage product, such as a soda, and the like.

In certain particular embodiments, the ingestible composition comprises fructose and the active compound or any of its comestibly acceptable salts. In some such embodiments, the introduction of the active compound (or salt) permits one to use less fructose (such as more than 10% less, more than 20% less, more than 30% less, more than 40% less, more than 50% less, more than 60% less, or more than 70% less) and still achieve a level of sweetness, umami, and/or kokumi characteristic of a comparable product that employs more fructose. In some embodiments, the concentration of the active compound, or its comestibly acceptable salts, is no more than 1000 ppm, or no more than 900 ppm, or no more than 800 ppm, or no more than 700 ppm, or no more than 600 ppm, or no more than 500 ppm, or no more than 400 ppm, or no more than 300 ppm, or no more than 200 ppm, or no more than 100 ppm, or no more than 50 ppm, or no more than 25 ppm, or no more than 10 ppm. In some embodiments, the ingestible composition is a food product, such as any of those specifically

listed below. In other embodiments, the ingestible composition is a beverage product, such as a soda, and the like.

In certain particular embodiments, the ingestible composition comprises high-fructose corn syrup and the active compound or any of its comestibly acceptable salts. In some such
5 embodiments, the introduction of the active compound (or salt) permits one to use less high-fructose corn syrup (such as more than 10% less, more than 20% less, more than 30% less, more than 40% less, more than 50% less, more than 60% less, or more than 70% less) and still achieve a level of sweetness, umami, and/or kokumi characteristic of a comparable product that employs more high-fructose corn syrup. In some embodiments, the
10 concentration of the active compound, or its comestibly acceptable salts, is no more than 1000 ppm, or no more than 900 ppm, or no more than 800 ppm, or no more than 700 ppm, or no more than 600 ppm, or no more than 500 ppm, or no more than 400 ppm, or no more than 300 ppm, or no more than 200 ppm, or no more than 100 ppm, or no more than 50 ppm, or no more than 25 ppm, or no more than 10 ppm. In some embodiments, the ingestible
15 composition is a food product, such as any of those specifically listed below. In other embodiments, the ingestible composition is a beverage product, such as a soda, and the like.

In certain particular embodiments, the ingestible composition comprises glucose (for example, D-glucose, in either its alpha or beta forms, or a combination thereof) and the active compound or any of its comestibly acceptable salts. In some such embodiments, the
20 introduction of the active compound (or salt) permits one to use less glucose (such as more than 10% less, more than 20% less, more than 30% less, more than 40% less, more than 50% less, more than 60% less, or more than 70% less) and still achieve a level of sweetness, umami, and/or kokumi characteristic of a comparable product that employs more glucose. In some embodiments, the concentration of the active compound, or its comestibly acceptable
25 salts, is no more than 1000 ppm, or no more than 900 ppm, or no more than 800 ppm, or no more than 700 ppm, or no more than 600 ppm, or no more than 500 ppm, or no more than 400 ppm, or no more than 300 ppm, or no more than 200 ppm, or no more than 100 ppm, or no more than 50 ppm, or no more than 25 ppm, or no more than 10 ppm. Such ingestible compositions can be in any suitable form. In some embodiments, the ingestible composition
30 is a food product, such as any of those specifically listed below. In other embodiments, the ingestible composition is a beverage product, such as a soda, and the like. The glucose can be introduced in any suitable form, such as natural syrups and the like.

In certain particular embodiments, the ingestible composition comprises sucralose and the active compound or any of its comestibly acceptable salts. In some such embodiments,

the introduction of the active compound (or salt) permits one to use less sucralose (such as more than 10% less, more than 20% less, more than 30% less, more than 40% less, more than 50% less, more than 60% less, or more than 70% less) and still achieve a level of sweetness, umami, and/or kokumi characteristic of a comparable product that employs more sucralose.

- 5 In some embodiments, the concentration of the active compound, or its comestibly acceptable salts, is no more than 1000 ppm, or no more than 900 ppm, or no more than 800 ppm, or no more than 700 ppm, or no more than 600 ppm, or no more than 500 ppm, or no more than 400 ppm, or no more than 300 ppm, or no more than 200 ppm, or no more than 100 ppm, or no more than 50 ppm, or no more than 25 ppm, or no more than 10 ppm. Such ingestible
- 10 compositions can be in any suitable form. In some embodiments, the ingestible composition is a food product, such as any of those specifically listed below. In other embodiments, the ingestible composition is a beverage product, such as a soda, and the like.

- In certain particular embodiments, the ingestible composition comprises rebaudiosides (such as rebaudioside A, rebaudioside D, rebaudioside E, rebaudioside M, or
- 15 any combination thereof) and the active compound or any of its comestibly acceptable salts. In some such embodiments, the introduction of the active compound (or salt) permits one to use less rebaudioside (such as more than 10% less, more than 20% less, more than 30% less, more than 40% less, more than 50% less, more than 60% less, or more than 70% less) and still achieve a level of sweetness, umami, and/or kokumi characteristic of a comparable
- 20 product that employs more rebaudioside. In some embodiments, the concentration of the active compound, or its comestibly acceptable salts, is no more than 1000 ppm, or no more than 900 ppm, or no more than 800 ppm, or no more than 700 ppm, or no more than 600 ppm, or no more than 500 ppm, or no more than 400 ppm, or no more than 300 ppm, or no more than 200 ppm, or no more than 100 ppm, or no more than 50 ppm, or no more than 25
- 25 ppm, or no more than 10 ppm. Such ingestible compositions can be in any suitable form. In some embodiments, the ingestible composition is a food product, such as any of those specifically listed below. In other embodiments, the ingestible composition is a beverage product, such as a soda, and the like.

- In certain particular embodiments, the ingestible composition comprises aceulfame K
- 30 and the active compound or any of its comestibly acceptable salts. In some such embodiments, the introduction of the active compound (or salt) permits one to use less acesulfame K (such as more than 10% less, more than 20% less, more than 30% less, more than 40% less, more than 50% less, more than 60% less, or more than 70% less) and still achieve a level of sweetness, umami, and/or kokumi characteristic of a comparable product

that employs more acesulfame K. In some embodiments, the concentration of the active compound, or its comestibly acceptable salts, is no more than 1000 ppm, or no more than 900 ppm, or no more than 800 ppm, or no more than 700 ppm, or no more than 600 ppm, or no more than 500 ppm, or no more than 400 ppm, or no more than 300 ppm, or no more than 200 ppm, or no more than 100 ppm, or no more than 50 ppm, or no more than 25 ppm, or no more than 10 ppm. Such ingestible compositions can be in any suitable form. In some embodiments, the ingestible composition is a food product, such as any of those specifically listed below. In other embodiments, the ingestible composition is a beverage product, such as a soda, and the like.

10 In certain particular embodiments, the ingestible composition comprises allulose and the active compound or any of its comestibly acceptable salts. In some such embodiments, the introduction of the active compound (or salt) permits one to use less allulose (such as more than 10% less, more than 20% less, more than 30% less, more than 40% less, more than 50% less, more than 60% less, or more than 70% less) and still achieve a level of sweetness, 15 umami, and/or kokumi characteristic of a comparable product that employs more allulose. In some embodiments, the concentration of the active compound, or its comestibly acceptable salts, is no more than 1000 ppm, or no more than 900 ppm, or no more than 800 ppm, or no more than 700 ppm, or no more than 600 ppm, or no more than 500 ppm, or no more than 400 ppm, or no more than 300 ppm, or no more than 200 ppm, or no more than 100 ppm, or 20 no more than 50 ppm, or no more than 25 ppm, or no more than 10 ppm. Such ingestible compositions can be in any suitable form. In some embodiments, the ingestible composition is a food product, such as any of those specifically listed below. In other embodiments, the ingestible composition is a beverage product, such as a soda, and the like.

In certain particular embodiments, the ingestible composition comprises erythritol and 25 the active compound or any of its comestibly acceptable salts. In some such embodiments, the introduction of the active compound (or salt) permits one to use less erythritol (such as more than 10% less, more than 20% less, more than 30% less, more than 40% less, more than 50% less, more than 60% less, or more than 70% less) and still achieve a level of sweetness, umami, and/or kokumi characteristic of a comparable product that employs more erythritol. 30 In some embodiments, the concentration of the active compound, or its comestibly acceptable salts, is no more than 1000 ppm, or no more than 900 ppm, or no more than 800 ppm, or no more than 700 ppm, or no more than 600 ppm, or no more than 500 ppm, or no more than 400 ppm, or no more than 300 ppm, or no more than 200 ppm, or no more than 100 ppm, or no more than 50 ppm, or no more than 25 ppm, or no more than 10 ppm. Such ingestible

compositions can be in any suitable form. In some embodiments, the ingestible composition is a food product, such as any of those specifically listed below. In other embodiments, the ingestible composition is a beverage product, such as a soda, and the like.

In certain particular embodiments, the ingestible composition comprises aspartame
5 and the active compound or any of its comestibly acceptable salts. In some such
embodiments, the introduction of the active compound (or salt) permits one to use less
aspartame (such as more than 10% less, more than 20% less, more than 30% less, more than
40% less, more than 50% less, more than 60% less, or more than 70% less) and still achieve a
level of sweetness, umami, and/or kokumi characteristic of a comparable product that
10 employs more aspartame. In some embodiments, the concentration of the active compound,
or its comestibly acceptable salts, is no more than 1000 ppm, or no more than 900 ppm, or no
more than 800 ppm, or no more than 700 ppm, or no more than 600 ppm, or no more than
500 ppm, or no more than 400 ppm, or no more than 300 ppm, or no more than 200 ppm, or
no more than 100 ppm, or no more than 50 ppm, or no more than 25 ppm, or no more than 10
15 ppm. Such ingestible compositions can be in any suitable form. In some embodiments, the
ingestible composition is a food product, such as any of those specifically listed below. In
other embodiments, the ingestible composition is a beverage product, such as a soda, and the
like.

In certain particular embodiments, the ingestible composition comprises cyclamate
20 and the active compound or any of its comestibly acceptable salts. In some such
embodiments, the introduction of the active compound (or salt) permits one to use less
cyclamate (such as more than 10% less, more than 20% less, more than 30% less, more than
40% less, more than 50% less, more than 60% less, or more than 70% less) and still achieve a
level of sweetness, umami, and/or kokumi characteristic of a comparable product that
25 employs more cyclamate. In some embodiments, the concentration of the active compound,
or its comestibly acceptable salts, is no more than 1000 ppm, or no more than 900 ppm, or no
more than 800 ppm, or no more than 700 ppm, or no more than 600 ppm, or no more than
500 ppm, or no more than 400 ppm, or no more than 300 ppm, or no more than 200 ppm, or
no more than 100 ppm, or no more than 50 ppm, or no more than 25 ppm, or no more than 10
30 ppm. Such ingestible compositions can be in any suitable form. In some embodiments, the
ingestible composition is a food product, such as any of those specifically listed below. In
other embodiments, the ingestible composition is a beverage product, such as a soda, and the
like.

In certain particular embodiments, the ingestible composition comprises a mogroside (such as mogroside III, mogroside IV, mogroside V, siamenoside, isomogroside V, mogroside IVE, isomogroside IV, mogroside IIIE, 11-oxomogroside V, and any combinations thereof) and the active compound or any of its comestibly acceptable salts. In some such embodiments, the introduction of the active compound (or salt) permits one to use less a mogroside (such as more than 10% less, more than 20% less, more than 30% less, more than 40% less, more than 50% less, more than 60% less, or more than 70% less) and still achieve a level of sweetness, umami, and/or kokumi characteristic of a comparable product that employs more mogroside. In some embodiments, the concentration of the active compound, or its comestibly acceptable salts, is no more than 1000 ppm, or no more than 900 ppm, or no more than 800 ppm, or no more than 700 ppm, or no more than 600 ppm, or no more than 500 ppm, or no more than 400 ppm, or no more than 300 ppm, or no more than 200 ppm, or no more than 100 ppm, or no more than 50 ppm, or no more than 25 ppm, or no more than 10 ppm. Such ingestible compositions can be in any suitable form. In some embodiments, the ingestible composition is a food product, such as any of those specifically listed below. In other embodiments, the ingestible composition is a beverage product, such as a soda, and the like. Additional mogroside compounds that may be suitably used are described in U.S. Patent Application Publication No. 2017/0119032.

In some other aspects, the disclosure provides use of the active compound, or a comestibly acceptable salt thereof, to enhance or confer an umami taste of an ingestible composition. In some embodiments, the concentration of the active compound, or its comestibly acceptable salts, is no more than 1000 ppm, or no more than 900 ppm, or no more than 800 ppm, or no more than 700 ppm, or no more than 600 ppm, or no more than 500 ppm, or no more than 400 ppm, or no more than 300 ppm, or no more than 200 ppm, or no more than 100 ppm, or no more than 50 ppm, or no more than 25 ppm, or no more than 10 ppm, in the ingestible composition. Such ingestible compositions can be in any suitable form. In some embodiments, the ingestible composition is a food product, such as any of those specifically listed below. In other embodiments, the ingestible composition is a beverage product, such as a soda, and the like.

In some other aspects, the disclosure provides use of the active compound, or a comestibly acceptable salt thereof, to enhance or confer a kokumi taste of an ingestible composition. In some embodiments, the concentration of the active compound, or its comestibly acceptable salts, is no more than 1000 ppm, or no more than 900 ppm, or no more than 800 ppm, or no more than 700 ppm, or no more than 600 ppm, or no more than 500

ppm, or no more than 400 ppm, or no more than 300 ppm, or no more than 200 ppm, or no more than 100 ppm, or no more than 50 ppm, or no more than 25 ppm, or no more than 10 ppm, in the ingestible composition. Such ingestible compositions can be in any suitable form. In some embodiments, the ingestible composition is a food product, such as any of those specifically listed below. In other embodiments, the ingestible composition is a beverage product, such as a soda, and the like.

In certain embodiments of any aspects and embodiments set forth herein that refer to an ingestible composition, the ingestible composition is a non-naturally-occurring product, such as a composition specifically manufactured for the production of a flavored product, such as food or beverage product.

In general, compounds as disclosed and described herein, individually or in combination, can be provided in a composition, such as an ingestible composition. In one embodiment, compounds as disclosed and described herein, individually or in combination, can impart a more sugar-like temporal profile or flavor profile to a sweetener composition by combining one or more of the compounds as disclosed and described herein with one or more sweeteners in the sweetener composition. In another embodiment, compounds as disclosed and described herein, individually or in combination, can increase or enhance the sweet taste of a composition by contacting the composition thereof with the compounds as disclosed and described herein to form a modified composition.

Thus, in some embodiments, the compositions set forth in any of the foregoing aspects (including in any uses or methods), comprise a flavor-modifying compound and a sweetener. In some embodiments, the composition further comprises a vehicle. In some embodiments, the vehicle is water. In some embodiments, the flavor-modifying compound is present at a concentration at or below its sweetness recognition threshold.

For example, in some embodiments, the sweetener (according to any of the embodiments set forth above) is present in an amount from about 0.1% to about 12% by weight. In some embodiments, the sweetener is present in an amount from about 0.2% to about 10% by weight. In some embodiments, the sweetener is present in an amount from about 0.3% to about 8% by weight. In some embodiments, the sweetener is present in an amount from about 0.4% to about 6% by weight. In some embodiments, the sweetener is present in an amount from about 0.5% to about 5% by weight. In some embodiments, the sweetener is present in an amount from about 1% to about 2% by weight. In some embodiments, the sweetener is present in an amount from about 0.1% to about 5% by weight. In some embodiments, the sweetener is present in an amount from about 0.1% to about 4%

by weight. In some embodiments, the sweetener is present in an amount from about 0.1% to about 3% by weight. In some embodiments, the sweetener is present in an amount from about 0.1% to about 2% by weight. In some embodiments, the sweetener is present in an amount from about 0.1% to about 1% by weight. In some embodiments, the sweetener is present in an amount from about 0.1% to about 0.5% by weight. In some embodiments, the sweetener is present in an amount from about 0.5% to about 10% by weight. In some embodiments, the sweetener is present in an amount from about 2% to about 8% by weight. In some further embodiments of the embodiments set forth in this paragraph, the sweetener is sucrose, fructose, glucose, xylitol, erythritol, or combinations thereof.

10 In some other embodiments, the sweetener is present in an amount from 10 ppm to 1000 ppm. In some embodiments, the sweetener is present in an amount from 20 ppm to 800 ppm. In some embodiments, the sweetener is present in an amount from 30 ppm to 600 ppm. In some embodiments, the sweetener is present in an amount from 40 ppm to 500 ppm. In some embodiments, the sweetener is present in an amount from 50 ppm to 400 ppm. In some
15 embodiments, the sweetener is present in an amount from 50 ppm to 300 ppm. In some embodiments, the sweetener is present in an amount from 50 ppm to 200 ppm. In some embodiments, the sweetener is present in an amount from 50 ppm to 150 ppm. In some further embodiments of the embodiments set forth in this paragraph, the sweetener is a steviol glycoside, a mogroside, a derivative of either of the foregoing, such as glycoside derivatives
20 (e.g., glucosylates), or any combination thereof.

The compositions can include any suitable sweeteners or combination of sweeteners. In some embodiments, the sweetener is a common saccharide sweeteners, such as sucrose, fructose, glucose, and sweetener compositions comprising natural sugars, such as corn syrup (including high fructose corn syrup) or other syrups or sweetener concentrates derived from
25 natural fruit and vegetable sources. In some embodiments, the sweetener is sucrose, fructose, or a combination thereof. In some embodiments, the sweetener is sucrose. In some other embodiments, the sweetener is selected from rare natural sugars including D-allose, D-psicose, L-ribose, D-tagatose, L-glucose, L-fucose, L-arabinose, D-turanose, and D-leucrose. In some embodiments, the sweetener is selected from semi-synthetic “sugar
30 alcohol” sweeteners such as erythritol, isomalt, lactitol, mannitol, sorbitol, xylitol, maltodextrin, and the like. In some embodiments, the sweetener is selected from artificial sweeteners such as aspartame, saccharin, acesulfame-K, cyclamate, sucralose, and alitame. In some embodiments, the sweetener is selected from the group consisting of cyclamic acid, mogroside, tagatose, maltose, galactose, mannose, sucrose, fructose, lactose, allulose,

neotame and other aspartame derivatives, glucose, D-tryptophan, glycine, maltitol, lactitol, isomalt, hydrogenated glucose syrup (HGS), hydrogenated starch hydrolyzate (HSH), stevioside, rebaudioside A, other sweet Stevia-based glycosides, chemically modified steviol glycosides (such as glucosylated steviol glycosides), mogrosides, chemically modified mogrosides (such as glucosylated mogrosides), carrelame and other guanidine-based sweeteners. In some embodiments, the sweetener is a combination of two or more of the sweeteners set forth in this paragraph. In some embodiments, the sweetener may combinations of two, three, four or five sweeteners as disclosed herein. In some embodiments, the sweetener may be a sugar. In some embodiments, the sweetener may be a combination of one or more sugars and other natural and artificial sweeteners. In some embodiments, the sweetener is a sugar. In some embodiments, the sugar is cane sugar. In some embodiments, the sugar is beet sugar. In some embodiments, the sugar may be sucrose, fructose, glucose or combinations thereof. In some embodiments, the sugar may be sucrose. In some embodiments, the sugar may be a combination of fructose and glucose.

The sweetener can also include, for example, sweetener compositions comprising one or more natural or synthetic carbohydrate, such as corn syrup, high fructose corn syrup, high maltose corn syrup, glucose syrup, sucralose syrup, hydrogenated glucose syrup (HGS), hydrogenated starch hydrolyzate (HSH), or other syrups or sweetener concentrates derived from natural fruit and vegetable sources, or semi-synthetic “sugar alcohol” sweeteners such as polyols. Non-limiting examples of polyols in some embodiments include erythritol, maltitol, mannitol, sorbitol, lactitol, xylitol, isomalt, propylene glycol, glycerol (glycerin), threitol, galactitol, palatinose, reduced isomalto-oligosaccharides, reduced xylo-oligosaccharides, reduced gentio-oligosaccharides, reduced maltose syrup, reduced glucose syrup, isomaltulose, maltodextrin, and the like, and sugar alcohols or any other carbohydrates or combinations thereof capable of being reduced which do not adversely affect taste.

The sweetener may be a natural or synthetic sweetener that includes, but is not limited to, agave inulin, agave nectar, agave syrup, amazake, brazzein, brown rice syrup, coconut crystals, coconut sugars, coconut syrup, date sugar, fructans (also referred to as inulin fiber, fructo-oligosaccharides, or oligo-fructose), green stevia powder, stevia rebaudiana, rebaudioside A, rebaudioside B, rebaudioside C, rebaudioside D, rebaudioside E, rebaudioside F, rebaudioside I, rebaudioside H, rebaudioside L, rebaudioside K, rebaudioside J, rebaudioside N, rebaudioside O, rebaudioside M and other sweet stevia-based glycosides, stevioside, stevioside extracts, honey, Jerusalem artichoke syrup, licorice root, luohan guo (fruit, powder, or extracts), lucuma (fruit, powder, or extracts), maple sap (including, for

- example, sap extracted from *Acer saccharum*, *Acer nigrum*, *Acer rubrum*, *Acer saccharinum*, *Acer platanoides*, *Acer negundo*, *Acer macrophyllum*, *Acer grandidentatum*, *Acer glabrum*, *Acer mono*), maple syrup, maple sugar, walnut sap (including, for example, sap extracted from *Juglans cinerea*, *Juglans nigra*, *Juglans ailatifolia*, *Juglans regia*), birch sap (including, for example, sap extracted from *Betula papyrifera*, *Betula alleghaniensis*, *Betula lenta*, *Betula nigra*, *Betula populifolia*, *Betula pendula*), sycamore sap (such as, for example, sap extracted from *Platanus occidentalis*), ironwood sap (such as, for example, sap extracted from *Ostrya virginiana*), mascobado, molasses (such as, for example, blackstrap molasses), molasses sugar, monatin, monellin, cane sugar (also referred to as natural sugar, unrefined cane sugar, or sucrose), palm sugar, panocha, piloncillo, rapadura, raw sugar, rice syrup, sorghum, sorghum syrup, cassava syrup (also referred to as tapioca syrup), thaumatin, yacon root, malt syrup, barley malt syrup, barley malt powder, beet sugar, cane sugar, crystalline juice crystals, caramel, carbitol, carob syrup, castor sugar, hydrogenated starch hydrolates, hydrolyzed can juice, hydrolyzed starch, invert sugar, anethole, arabinogalactan, arrope, syrup, P-4000, acesulfame potassium (also referred to as acesulfame K or ace-K), alitame (also referred to as aclame), advantame, aspartame, baiyunoside, neotame, benzamide derivatives, bernadame, canderel, carrelame and other guanidine-based sweeteners, vegetable fiber, corn sugar, coupling sugars, curculin, cyclamates, cyclocarioside I, demerara, dextran, dextrin, diastatic malt, dulcin, sucrol, valzin, dulcoside A, dulcoside B, emulin, enoxolone, maltodextrin, saccharin, estragole, ethyl maltol, glucin, gluconic acid, glucono-lactone, glucosamine, glucuronic acid, glycerol, glycine, glycyphillin, glycyrrhizin, glycyrrhetic acid monoglucuronide, golden sugar, yellow sugar, golden syrup, granulated sugar, gynostemma, hernandulcin, isomerized liquid sugars, jallab, chicory root dietary fiber, kynurenine derivatives (including N'-formyl-kynurenine, N'-acetyl-kynurenine, 6-chloro-kynurenine), galactitol, litesse, ligicane, lycasin, lugduname, guanidine, falernum, mabinlin I, mabinlin II, maltol, maltisorb, maltodextrin, maltotriol, mannosamine, miraculin, mizuame, mogrosides (including, for example, mogroside IV, mogroside V, and neomogroside), mukurozioside, nano sugar, naringin dihydrochalcone, neohesperidine dihydrochalcone, nib sugar, nigero-oligosaccharide, norbu, orgeat syrup, osladin, pekmez, pentadin, periandrin I, perillaldehyde, perillartine, petphyllum, phenylalanine, phlomisoside I, phlorodizin, phyllodulcin, polyglycitol syrups, polypodoside A, pterocaryoside A, pterocaryoside B, rebiana, refiners syrup, rub syrup, rubusoside, selliguaein A, shugr, siamenoside I, siraitia grosvenorii, soybean oligosaccharide, Splenda, SRI oxime V, steviol glycoside, steviolbioside, stevioside, strogins 1, 2, and 4, sucronic acid, sucrononate, sugar, suosan, phloridzin, superaspartame,

tetrasaccharide, threitol, treacle, trilobtain, tryptophan and derivatives (6-trifluoromethyl-tryptophan, 6-chloro-D-tryptophan), vanilla sugar, volemitol, birch syrup, aspartame-acesulfame, assugrin, and combinations or blends of any two or more thereof.

In still other embodiments, the sweetener can be a chemically or enzymatically modified natural high potency sweetener. Modified natural high potency sweeteners include glycosylated natural high potency sweetener such as glucosyl-, galactosyl-, or fructosyl-derivatives containing 1-50 glycosidic residues. Glycosylated natural high potency sweeteners may be prepared by enzymatic transglycosylation reaction catalyzed by various enzymes possessing transglycosylating activity. In some embodiments, the modified sweetener can be substituted or unsubstituted.

Additional sweeteners also include combinations of any two or more of any of the aforementioned sweeteners. In some embodiments, the sweetener may comprise combinations of two, three, four or five sweeteners as disclosed herein. In some embodiments, the sweetener may be a sugar. In some embodiments, the sweetener may be a combination of one or more sugars and other natural and artificial sweeteners. In some embodiments, the sweetener is a caloric sweetener, such as sucrose, fructose, xylitol, erythritol, or combinations thereof. In some embodiments, the ingestible compositions are free (or, in some embodiments) substantially free of stevia-derived sweeteners, such as steviol glycosides, glucosylated steviol glycosides, or rebaudiosides. For example, in some embodiments, the ingestible compositions are either free of stevia-derived sweeteners or comprise stevia-derived sweeteners in a concentration of no more than 1000 ppm, or no more than 500 ppm, or no more than 200 ppm, or no more than 100 ppm, or no more than 50 ppm, or no more than 20 ppm, or no more than 10 ppm, or no more than 5 ppm, or no more than 3 ppm, or no more than 1 ppm.

The flavor-modifying compounds can be present in the ingestible compositions in any suitable amount. In some embodiments, the flavor-modifying compounds are present in an amount sufficient to enhance the taste (e.g., enhance the sweetness, reduce the sourness, or reduce the bitterness) of the compositions. Thus, in some embodiments, the ingestible composition comprises the flavor-modifying compound in a concentration no greater than 200 ppm, or no greater than 150 ppm, or no greater than 100 ppm, or no greater than 50 ppm, or no greater than 40 ppm, or no greater than 30 ppm, or no greater than 20 ppm. In some embodiments, the flavor-modifying compound is present in a minimum amount, such as 1 ppm or 5 ppm. Thus, in some embodiments, the ingestible composition comprises the flavor-modifying compound in a concentration ranging from 1 ppm to 200 ppm, or from 1 ppm to

150 ppm, or from 1 ppm to 100 ppm, or from 1 ppm to 50 ppm, or from 1 ppm to 40 ppm, or from 1 ppm to 30 ppm, or from 1 ppm to 20 ppm, or from 5 ppm to 200 ppm, or from 5 ppm to 150 ppm, or from 5 ppm to 100 ppm, or from 5 ppm to 50 ppm, or from 5 ppm to 40 ppm, or from 5 ppm to 30 ppm, or from 5 ppm to 20 ppm. In embodiments where a sweetener,
 5 such as sucrose or fructose, are present, the weight-to-weight ratio of sweetener to the flavor-modifying compound in the ingestible composition ranges from 1000:1 to 50000:1, or from 1000:1 to 10000:1, or from 2000:1 to 8000:1.

The ingestible compositions or sweetener concentrates can, in certain embodiments, comprise any additional ingredients or combination of ingredients as are commonly used in
 10 food and beverage products, including, but not limited to:

acids, including, for example citric acid, phosphoric acid, ascorbic acid, sodium acid sulfate, lactic acid, or tartaric acid;

bitter ingredients, including, for example caffeine, quinine, green tea, catechins, polyphenols, green robusta coffee extract, green coffee extract, potassium chloride, menthol,
 15 or proteins (such as proteins and protein isolates derived from plants, algae, or fungi);

coloring agents, including, for example caramel color, Red #40, Yellow #5, Yellow #6, Blue #1, Red #3, purple carrot, black carrot juice, purple sweet potato, vegetable juice, fruit juice, beta carotene, turmeric curcumin, or titanium dioxide;

preservatives, including, for example sodium benzoate, potassium benzoate,
 20 potassium sorbate, sodium metabisulfate, sorbic acid, or benzoic acid;

antioxidants including, for example ascorbic acid, calcium disodium EDTA, alpha tocopherols, mixed tocopherols, rosemary extract, grape seed extract, resveratrol, or sodium hexametaphosphate;

vitamins or functional ingredients including, for example resveratrol, Co-Q10, omega
 25 3 fatty acids, theanine, choline chloride (citocoline), fibersol, inulin (chicory root), taurine, panax ginseng extract, guanana extract, ginger extract, L-phenylalanine, L-carnitine, L-tartrate, D-glucoronolactone, inositol, bioflavonoids, Echinacea, ginko biloba, yerba mate, flax seed oil, garcinia cambogia rind extract, white tea extract, ribose, milk thistle extract, grape seed extract, pyrodixine HCl (vitamin B6), cyanoobalamin (vitamin B12), niacinamide
 30 (vitamin B3), biotin, calcium lactate, calcium pantothenate (pantothenic acid), calcium phosphate, calcium carbonate, chromium chloride, chromium polynicotinate, cupric sulfate, folic acid, ferric pyrophosphate, iron, magnesium lactate, magnesium carbonate, magnesium sulfate, monopotassium phosphate, monosodium phosphate, phosphorus, potassium iodide, potassium phosphate, riboflavin, sodium sulfate, sodium gluconate, sodium polyphosphate,

sodium bicarbonate, thiamine mononitrate, vitamin D3, vitamin A palmitate, zinc gluconate, zinc lactate, or zinc sulphate;

clouding agents, including, for example ester gum, brominated vegetable oil (BVO), or sucrose acetate isobutyrate (SAIB);

5 buffers, including, for example sodium citrate, potassium citrate, or salt;

flavors, including, for example propylene glycol, ethyl alcohol, glycerine, gum Arabic (gum acacia), maltodextrin, modified corn starch, dextrose, natural flavor, natural flavor with other natural flavors (natural flavor WONF), natural and artificial flavors, artificial flavor, silicon dioxide, magnesium carbonate, or tricalcium phosphate; or

10 starches and stabilizers, including, for example pectin, xanthan gum, carboxymethylcellulose (CMC), polysorbate 60, polysorbate 80, medium chain triglycerides, cellulose gel, cellulose gum, sodium caseinate, modified food starch, gum Arabic (gum acacia), inulin, or carrageenan.

The ingestible compositions or sweetener concentrates can have any suitable pH. In some embodiments, the flavor-modifying compounds enhance the sweetness of a sweetener under a broad range of pH, e.g., from lower pH to neutral pH. The lower and neutral pH includes, but is not limited to, a pH from 1.5 to 9.0, or from 2.5 to 8.5; from 3.0 to 8.0; from 3.5 to 7.5; and from 4.0 to 7. In certain embodiments, compounds as disclosed and described herein, individually or in combination, can enhance the perceived sweetness of a fixed concentration of a sweetener in taste tests at a compound concentration of 50 μ M, 40 μ M, 30 μ M, 20 μ M, or 10 μ M at both low to neutral pH value. In certain embodiments, the enhancement factor of the compounds as disclosed and described herein, individually or in combination, at the lower pH is substantially similar to the enhancement factor of the compounds at neutral pH. Such consistent sweet enhancing property under a broad range of pH allow a broad use in a wide variety of foods and beverages of the compounds as disclosed and described herein, individually or in combination.

The ingestible compositions set forth according to any of the foregoing embodiments, also include, in certain embodiments, one or more additional flavor-modifying compounds, such as compounds that enhance sweetness (e.g., hesperetin, naringenin, glucosylated steviol glycosides, etc.), compounds that block bitterness, compounds that enhance umami, compounds that reduce sourness or licorice taste, compounds that enhance saltiness, compounds that enhance a cooling effect, or any combinations of the foregoing.

Thus, in some embodiments, ingestible compositions disclosed herein comprise the active compound, or any comestibly acceptable salts thereof, according to any of the

embodiments or combination of embodiments set forth above, are combined with one or more sweetness enhancing compounds. Such sweetness enhancing compounds include, but are not limited to, naturally derived compounds, such as hesperitin, naringenin, glucosylated steviol glycosides, or synthetic compounds, such as any compounds set forth in U.S. Patent Nos. 8,541,421; 8,815,956; 9,834,544; 8,592,592; 8,877,922; 9,000,054; and 9,000,051, as well as U.S. Patent Application Publication No. 2017/0119032. The active compound (or comestibly acceptable salts thereof) may be used in combination with such other sweetness enhancers in any suitable ratio (w/w) ranging from 1:1000 to 1000:1, or from 1:100 to 100:1, or from, 1:50 to 50:1, or from 1:25 to 25:1, or from 1:10 to 10:1, such as 1:25, 1:24, 1:23, 1:22, 1:21, 1:20, 1:19, 1:18, 1:17, 1:16, 1:15, 1:14, 1:13, 1:12, 1:11, 1:10, 1:9, 1:8, 1:7, 1:6, 1:5, 1:4, 1:3, 1:2, 1:1, 2:1, 3:1, 4:1, 5:1, 6:1, 7:1, 8:1, 9:1, 10:1, 11:1, 12:1, 13:1, 14:1, 15:1, 16:1, 17:1, 18:1, 19:1, 20:1, 21:1, 22:1, 23:1, 24:1, or 25:1. In some embodiments of any of the preceding embodiments, the active compound (or any comestibly acceptable salts thereof) is combined with glucosylated steviol glycosides in any of the above ratios. As used herein, the term “glucosylated steviol glycoside” refers to the product of enzymatically glucosylating natural steviol glycoside compounds. The glucosylation generally occurs through a glycosidic bond, such as an α -1,2 bond, an α -1,4 bond, an α -1,6 bond, a β -1,2 bond, a β -1,4 bond, a β -1,6 bond, and so forth. In some embodiments of any of the preceding embodiments, the active compound (or any comestibly acceptable salts thereof) is combined with 3-((4-amino-2,2-dioxo-1*H*-benzo[*c*][1,2,6]thiadiazin-5-yl)oxy)-2,2-dimethyl-*N*-propylpropanamide, *N*-(1-((4-amino-2,2-dioxo-1*H*-benzo[*c*][1,2,6]thiadiazin-5-yl)oxy)-2-methylpropan-2-yl)isonicotinamide, or any combination thereof, in any of the above ratios.

In some further embodiments, ingestible compositions disclosed herein comprise the active compound, or any comestibly acceptable salts thereof, according to any of the embodiments or combination of embodiments set forth above, are combined with one or more other umami or kokumi enhancing compounds. Such umami enhancing compounds include, but are not limited to, naturally derived compounds, such as ericamide, or synthetic compounds, such as any compounds set forth in U.S. Patent Nos. 8,735,081; 8,124,121; and 8,968,708. The active compound (or comestibly acceptable salts thereof) may be used in combination with such umami enhancers in any suitable ratio (w/w) ranging from 1:1000 to 1000:1, or from 1:100 to 100:1, or from, 1:50 to 50:1, or from 1:25 to 25:1, or from 1:10 to 10:1, such as 1:25, 1:24, 1:23, 1:22, 1:21, 1:20, 1:19, 1:18, 1:17, 1:16, 1:15, 1:14, 1:13, 1:12, 1:11, 1:10, 1:9, 1:8, 1:7, 1:6, 1:5, 1:4, 1:3, 1:2, 1:1, 2:1, 3:1, 4:1, 5:1, 6:1, 7:1, 8:1, 9:1, 10:1, 11:1, 12:1, 13:1, 14:1, 15:1, 16:1, 17:1, 18:1, 19:1, 20:1, 21:1, 22:1, 23:1, 24:1, or 25:1.

In some further embodiments, ingestible compositions disclosed herein comprise the active compound, or any comestibly acceptable salts thereof, according to any of the embodiments or combination of embodiments set forth above, are combined with one or more cooling enhancing compounds. Such cooling enhancing compounds include, but are not limited to, naturally derived compounds, such as menthol or analogs thereof, or synthetic compounds, such as any compounds set forth in U.S. Patent Nos. 9,394,287 and 10,421,727. The active compound (or comestibly acceptable salts thereof) may be used in combination with such umami enhancers in any suitable ratio (w/w) ranging from 1:1000 to 1000:1, or from 1:100 to 100:1, or from, 1:50 to 50:1, or from 1:25 to 25:1, or from 1:10 to 10:1, such as 1:25, 1:24, 1:23, 1:22, 1:21, 1:20, 1:19, 1:18, 1:17, 1:16, 1:15, 1:14, 1:13, 1:12, 1:11, 1:10, 1:9, 1:8, 1:7, 1:6, 1:5, 1:4, 1:3, 1:2, 1:1, 2:1, 3:1, 4:1, 5:1, 6:1, 7:1, 8:1, 9:1, 10:1, 11:1, 12:1, 13:1, 14:1, 15:1, 16:1, 17:1, 18:1, 19:1, 20:1, 21:1, 22:1, 23:1, 24:1, or 25:1.

In some further embodiments, ingestible compositions disclosed herein comprise the active compound, or any comestibly acceptable salts thereof, according to any of the embodiments or combination of embodiments set forth above, are combined with one or more bitterness blocking compounds. Such bitterness blocking compounds include, but are not limited to, naturally derived compounds, such as menthol or analogs thereof, or synthetic compounds, such as any compounds set forth in U.S. Patent Nos. 8,076,491; 8,445,692; and 9,247,759. The active compound (or comestibly acceptable salts thereof) may be used in combination with such bitterness blockers in any suitable ratio (w/w) ranging from 1:1000 to 1000:1, or from 1:100 to 100:1, or from, 1:50 to 50:1, or from 1:25 to 25:1, or from 1:10 to 10:1, such as 1:25, 1:24, 1:23, 1:22, 1:21, 1:20, 1:19, 1:18, 1:17, 1:16, 1:15, 1:14, 1:13, 1:12, 1:11, 1:10, 1:9, 1:8, 1:7, 1:6, 1:5, 1:4, 1:3, 1:2, 1:1, 2:1, 3:1, 4:1, 5:1, 6:1, 7:1, 8:1, 9:1, 10:1, 11:1, 12:1, 13:1, 14:1, 15:1, 16:1, 17:1, 18:1, 19:1, 20:1, 21:1, 22:1, 23:1, 24:1, or 25:1.

In some further embodiments, ingestible compositions disclosed herein comprise the active compound, or any comestibly acceptable salts thereof, according to any of the embodiments or combination of embodiments set forth above, are combined with one or more sour taste modulating compounds. The active compound (or comestibly acceptable salts thereof) may be used in combination with such sour taste modulating compounds in any suitable ratio (w/w) ranging from 1:1000 to 1000:1, or from 1:100 to 100:1, or from, 1:50 to 50:1, or from 1:25 to 25:1, or from 1:10 to 10:1, such as 1:25, 1:24, 1:23, 1:22, 1:21, 1:20, 1:19, 1:18, 1:17, 1:16, 1:15, 1:14, 1:13, 1:12, 1:11, 1:10, 1:9, 1:8, 1:7, 1:6, 1:5, 1:4, 1:3, 1:2, 1:1, 2:1, 3:1, 4:1, 5:1, 6:1, 7:1, 8:1, 9:1, 10:1, 11:1, 12:1, 13:1, 14:1, 15:1, 16:1, 17:1, 18:1, 19:1, 20:1, 21:1, 22:1, 23:1, 24:1, or 25:1.

In some further embodiments, ingestible compositions disclosed herein comprise the active compound, or any comestibly acceptable salts thereof, according to any of the embodiments or combination of embodiments set forth above, are combined with one or more mouthfeel modifying compounds. Such mouthfeel modifying compounds include, but are not limited to, tannins, cellulosic materials, bamboo powder, and the like. The active compound (or comestibly acceptable salts thereof) may be used in combination with such mouthfeel enhancers in any suitable ratio (w/w) ranging from 1:1000 to 1000:1, or from 1:100 to 100:1, or from, 1:50 to 50:1, or from 1:25 to 25:1, or from 1:10 to 10:1, such as 1:25, 1:24, 1:23, 1:22, 1:21, 1:20, 1:19, 1:18, 1:17, 1:16, 1:15, 1:14, 1:13, 1:12, 1:11, 1:10, 1:9, 1:8, 1:7, 1:6, 1:5, 1:4, 1:3, 1:2, 1:1, 2:1, 3:1, 4:1, 5:1, 6:1, 7:1, 8:1, 9:1, 10:1, 11:1, 12:1, 13:1, 14:1, 15:1, 16:1, 17:1, 18:1, 19:1, 20:1, 21:1, 22:1, 23:1, 24:1, or 25:1.

In some further embodiments, ingestible compositions disclosed herein comprise the active compound, or any comestibly acceptable salts thereof, according to any of the embodiments or combination of embodiments set forth above, are combined with one or more flavor masking compounds. Such flavor masking compounds include, but are not limited to, cellulosic materials, materials extracted from fungus, materials extracted from plants, citric acid, carbonic acid (or carbonates), and the like. The active compound (or comestibly acceptable salts thereof) may be used in combination with such mouthfeel enhancers in any suitable ratio (w/w) ranging from 1:1000 to 1000:1, or from 1:100 to 100:1, or from, 1:50 to 50:1, or from 1:25 to 25:1, or from 1:10 to 10:1, such as 1:25, 1:24, 1:23, 1:22, 1:21, 1:20, 1:19, 1:18, 1:17, 1:16, 1:15, 1:14, 1:13, 1:12, 1:11, 1:10, 1:9, 1:8, 1:7, 1:6, 1:5, 1:4, 1:3, 1:2, 1:1, 2:1, 3:1, 4:1, 5:1, 6:1, 7:1, 8:1, 9:1, 10:1, 11:1, 12:1, 13:1, 14:1, 15:1, 16:1, 17:1, 18:1, 19:1, 20:1, 21:1, 22:1, 23:1, 24:1, or 25:1.

In some aspects related to the preceding aspects and embodiments, the disclosure provides uses of the active compound (or comestibly acceptable salts thereof) to enhance the flavor of a flavored composition, such as a flavored article. Such flavored compositions can use any suitable flavors, such as fruit flavors, meat flavors, vegetable flavors, and the like. In some embodiments, the flavored composition is a soup or broth, or a chip, or a beverage.

Flavored Products and Concentrates

In certain aspects, the disclosure provides flavored products comprising any compositions of the preceding aspects. In some embodiments, the flavored products are beverage products, such as soda, flavored water, tea, and the like. In some other embodiments, the flavored products are food products, such as yogurt.

In embodiments where the flavored product is a beverage, the beverage may be selected from the group consisting of enhanced sparkling beverages, colas, lemon-lime flavored sparkling beverages, orange flavored sparkling beverages, grape flavored sparkling beverages, strawberry flavored sparkling beverages, pineapple flavored sparkling beverages, ginger-ales, root beers, fruit juices, fruit-flavored juices, juice drinks, nectars, vegetable juices, vegetable-flavored juices, sports drinks, energy drinks, enhanced water drinks, enhanced water with vitamins, near water drinks, coconut waters, tea type drinks, coffees, cocoa drinks, beverages containing milk components, beverages containing cereal extracts and smoothies. In some embodiments, the beverage may be a soft drink.

In certain embodiments of any aspects and embodiments set forth herein that refer to an flavored product, the flavored product is a non-naturally-occurring product, such as a packaged food or beverage product.

Further non-limiting examples of food and beverage products or formulations include sweet coatings, frostings, or glazes for such products or any entity included in the Soup category, the Dried Processed Food category, the Beverage category, the Ready Meal category, the Canned or Preserved Food category, the Frozen Processed Food category, the Chilled Processed Food category, the Snack Food category, the Baked Goods category, the Confectionery category, the Dairy Product category, the Ice Cream category, the Meal Replacement category, the Pasta and Noodle category, and the Sauces, Dressings, Condiments category, the Baby Food category, and/or the Spreads category.

In general, the Soup category refers to canned/preserved, dehydrated, instant, chilled, UHT and frozen soup. For the purpose of this definition soup(s) means a food prepared from meat, poultry, fish, vegetables, grains, fruit and other ingredients, cooked in a liquid which may include visible pieces of some or all of these ingredients. It may be clear (as a broth) or thick (as a chowder), smooth, pureed or chunky, ready-to-serve, semi-condensed or condensed and may be served hot or cold, as a first course or as the main course of a meal or as a between meal snack (sipped like a beverage). Soup may be used as an ingredient for preparing other meal components and may range from broths (consommé) to sauces (cream or cheese-based soups).

The Dehydrated and Culinary Food Category usually means: (i) Cooking aid products such as: powders, granules, pastes, concentrated liquid products, including concentrated bouillon, bouillon and bouillon like products in pressed cubes, tablets or powder or granulated form, which are sold separately as a finished product or as an ingredient within a product, sauces and recipe mixes (regardless of technology); (ii) Meal solutions products

such as: dehydrated and freeze dried soups, including dehydrated soup mixes, dehydrated instant soups, dehydrated ready-to-cook soups, dehydrated or ambient preparations of ready-made dishes, meals and single serve entrees including pasta, potato and rice dishes; and (iii) Meal embellishment products such as: condiments, marinades, salad dressings, salad

5 toppings, dips, breading, batter mixes, shelf stable spreads, barbecue sauces, liquid recipe mixes, concentrates, sauces or sauce mixes, including recipe mixes for salad, sold as a finished product or as an ingredient within a product, whether dehydrated, liquid or frozen.

The Beverage category usually means beverages, beverage mixes and concentrates, including but not limited to, carbonated and non-carbonated beverages, alcoholic and non-

10 alcoholic beverages, ready to drink beverages, liquid concentrate formulations for preparing beverages such as sodas, and dry powdered beverage precursor mixes. The Beverage category also includes the alcoholic drinks, the soft drinks, sports drinks, isotonic beverages, and hot drinks. The alcoholic drinks include, but are not limited to beer, cider/perry, FABs, wine, and spirits. The soft drinks include, but are not limited to carbonates, such as colas and

15 non-cola carbonates; fruit juice, such as juice, nectars, juice drinks and fruit flavored drinks; bottled water, which includes sparkling water, spring water and purified/table water; functional drinks, which can be carbonated or still and include sport, energy or elixir drinks; concentrates, such as liquid and powder concentrates in ready to drink measure. The drinks, either hot or cold, include, but are not limited to coffee or ice coffee, such as fresh, instant,

20 and combined coffee; tea or ice tea, such as black, green, white, oolong, and flavored tea; and other drinks including flavor-, malt- or plant-based powders, granules, blocks or tablets mixed with milk or water.

The Snack Food category generally refers to any food that can be a light informal meal including, but not limited to Sweet and savory snacks and snack bars. Examples of

25 snack food include, but are not limited to fruit snacks, chips/crisps, extruded snacks, tortilla/corn chips, popcorn, pretzels, nuts and other sweet and savory snacks. Examples of snack bars include, but are not limited to granola/muesli bars, breakfast bars, energy bars, fruit bars and other snack bars.

The Baked Goods category generally refers to any edible product the process of

30 preparing which involves exposure to heat or excessive sunlight. Examples of baked goods include, but are not limited to bread, buns, cookies, muffins, cereal, toaster pastries, pastries, waffles, tortillas, biscuits, pies, bagels, tarts, quiches, cake, any baked foods, and any combination thereof.

The Ice Cream category generally refers to frozen dessert containing cream and sugar and flavoring. Examples of ice cream include, but are not limited to: impulse ice cream; take-home ice cream; frozen yoghurt and artisanal ice cream; soy, oat, bean (e.g., red bean and mung bean), and rice-based ice creams.

- 5 The Confectionery category generally refers to edible product that is sweet to the taste. Examples of confectionery include, but are not limited to candies, gelatins, chocolate confectionery, sugar confectionery, gum, and the likes and any combination products.

- The Meal Replacement category generally refers to any food intended to replace the normal meals, particularly for people having health or fitness concerns. Examples of meal replacement include, but are not limited to slimming products and convalescence products.
- 10

- The Ready Meal category generally refers to any food that can be served as meal without extensive preparation or processing. The ready meal includes products that have had recipe “skills” added to them by the manufacturer, resulting in a high degree of readiness, completion and convenience. Examples of ready meal include, but are not limited to
- 15 canned/preserved, frozen, dried, chilled ready meals; dinner mixes; frozen pizza; chilled pizza; and prepared salads.

 The Pasta and Noodle category includes any pastas and/or noodles including, but not limited to canned, dried and chilled/fresh pasta; and plain, instant, chilled, frozen and snack noodles.

- 20 The Canned/Preserved Food category includes, but is not limited to canned/preserved meat and meat products, fish/seafood, vegetables, tomatoes, beans, fruit, ready meals, soup, pasta, and other canned/preserved foods.

- The Frozen Processed Food category includes, but is not limited to frozen processed red meat, processed poultry, processed fish/seafood, processed vegetables, meat substitutes,
- 25 processed potatoes, bakery products, desserts, ready meals, pizza, soup, noodles, and other frozen food.

- The Dried Processed Food category includes, but is not limited to rice, dessert mixes, dried ready meals, dehydrated soup, instant soup, dried pasta, plain noodles, and instant noodles. The Chill Processed Food category includes, but is not limited to chilled processed
- 30 meats, processed fish/seafood products, lunch kits, fresh cut fruits, ready meals, pizza, prepared salads, soup, fresh pasta and noodles.

 The Sauces, Dressings and Condiments category includes, but is not limited to tomato pastes and purees, bouillon/stock cubes, herbs and spices, monosodium glutamate (MSG), table sauces, soy based sauces, pasta sauces, wet/cooking sauces, dry sauces/powder mixes,

ketchup, mayonnaise, mustard, salad dressings, vinaigrettes, dips, pickled products, and other sauces, dressings and condiments.

The Baby Food category includes, but is not limited to milk- or soybean-based formula; and prepared, dried and other baby food.

- 5 The Spreads category includes, but is not limited to jams and preserves, honey, chocolate spreads, nut based spreads, and yeast based spreads.

The Dairy Product category generally refers to edible product produced from mammal's milk. Examples of dairy product include, but are not limited to drinking milk products, cheese, yoghurt and sour milk drinks, and other dairy products.

- 10 Additional examples for flavored products, particularly food and beverage products or formulations, are provided as follows. Exemplary ingestible compositions include one or more confectioneries, chocolate confectionery, tablets, countlines, bagged selflines/softlines, boxed assortments, standard boxed assortments, twist wrapped miniatures, seasonal chocolate, chocolate with toys, alfajores, other chocolate confectionery, mints, standard
- 15 mints, power mints, boiled sweets, pastilles, gums, jellies and chews, toffees, caramels and nougat, medicated confectionery, lollipops, liquorice, other sugar confectionery, bread, packaged/industrial bread, unpackaged/artisanal bread, pastries, cakes, packaged/industrial cakes, unpackaged/artisanal cakes, cookies, chocolate coated biscuits, sandwich biscuits, filled biscuits, savory biscuits and crackers, bread substitutes, breakfast cereals, rte cereals,
- 20 family breakfast cereals, flakes, muesli, other cereals, children's breakfast cereals, hot cereals, ice cream, impulse ice cream, single portion dairy ice cream, single portion water ice cream, multi-pack dairy ice cream, multi-pack water ice cream, take-home ice cream, take-home dairy ice cream, ice cream desserts, bulk ice cream, take-home water ice cream, frozen yoghurt, artisanal ice cream, dairy products, milk, fresh/pasteurized milk, full fat
- 25 fresh/pasteurized milk, semi skimmed fresh/pasteurized milk, long-life/uht milk, full fat long life/uht milk, semi skimmed long life/uht milk, fat-free long life/uht milk, goat milk, condensed/evaporated milk, plain condensed/evaporated milk, flavored, functional and other condensed milk, flavored milk drinks, dairy only flavored milk drinks, flavored milk drinks with fruit juice, soy milk, sour milk drinks, fermented dairy drinks, coffee whiteners, powder
- 30 milk, flavored powder milk drinks, cream, cheese, processed cheese, spreadable processed cheese, unspreadable processed cheese, unprocessed cheese, spreadable unprocessed cheese, hard cheese, packaged hard cheese, unpackaged hard cheese, yoghurt, plain/natural yoghurt, flavored yoghurt, fruited yoghurt, probiotic yoghurt, drinking yoghurt, regular drinking yoghurt, probiotic drinking yoghurt, chilled and shelf-stable desserts, dairy-based desserts,

- soy-based desserts, chilled snacks, fromage frais and quark, plain fromage frais and quark, flavored fromage frais and quark, savory fromage frais and quark, sweet and savory snacks, fruit snacks, chips/crisps, extruded snacks, tortilla/corn chips, popcorn, pretzels, nuts, other sweet and savory snacks, snack bars, granola bars, breakfast bars, energy bars, fruit bars,
- 5 other snack bars, meal replacement products, slimming products, convalescence drinks, ready meals, canned ready meals, frozen ready meals, dried ready meals, chilled ready meals, dinner mixes, frozen pizza, chilled pizza, soup, canned soup, dehydrated soup, instant soup, chilled soup, hot soup, frozen soup, pasta, canned pasta, dried pasta, chilled/fresh pasta, noodles, plain noodles, instant noodles, cups/bowl instant noodles, pouch instant noodles,
- 10 chilled noodles, snack noodles, canned food, canned meat and meat products, canned fish/seafood, canned vegetables, canned tomatoes, canned beans, canned fruit, canned ready meals, canned soup, canned pasta, other canned foods, frozen food, frozen processed red meat, frozen processed poultry, frozen processed fish/seafood, frozen processed vegetables, frozen meat substitutes, frozen potatoes, oven baked potato chips, other oven baked potato
- 15 products, non-oven frozen potatoes, frozen bakery products, frozen desserts, frozen ready meals, frozen pizza, frozen soup, frozen noodles, other frozen food, dried food, dessert mixes, dried ready meals, dehydrated soup, instant soup, dried pasta, plain noodles, instant noodles, cups/bowl instant noodles, pouch instant noodles, chilled food, chilled processed meats, chilled fish/seafood products, chilled processed fish, chilled coated fish, chilled smoked fish,
- 20 chilled lunch kit, chilled ready meals, chilled pizza, chilled soup, chilled/fresh pasta, chilled noodles, oils and fats, olive oil, vegetable and seed oil, cooking fats, butter, margarine, spreadable oils and fats, functional spreadable oils and fats, sauces, dressings and condiments, tomato pastes and purees, bouillon/stock cubes, stock cubes, gravy granules, liquid stocks and fonds, herbs and spices, fermented sauces, soy based sauces, pasta sauces,
- 25 wet sauces, dry sauces/powder mixes, ketchup, mayonnaise, regular mayonnaise, mustard, salad dressings, regular salad dressings, low fat salad dressings, vinaigrettes, dips, pickled products, other sauces, dressings and condiments, baby food, milk formula, standard milk formula, follow-on milk formula, toddler milk formula, hypoallergenic milk formula, prepared baby food, dried baby food, other baby food, spreads, jams and preserves, honey,
- 30 chocolate spreads, nut-based spreads, and yeast-based spreads. Exemplary ingestible compositions also include confectioneries, bakery products, ice creams, dairy products, sweet and savory snacks, snack bars, meal replacement products, ready meals, soups, pastas, noodles, canned foods, frozen foods, dried foods, chilled foods, oils and fats, baby foods, or spreads or a mixture thereof. Exemplary ingestible compositions also include breakfast

cereals, sweet beverages or solid or liquid concentrate compositions for preparing beverages, ideally so as to enable the reduction in concentration of previously known saccharide sweeteners, or artificial sweeteners.

Some embodiments provide a chewable composition that may or may not be intended to be swallowed. In some embodiments, the chewable composition may be gum, chewing gum, sugarized gum, sugar-free gum, functional gum, bubble gum including compounds as disclosed and described herein, individually or in combination.

Typically at least a sweet receptor modulating amount, a sweet receptor ligand modulating amount, a sweet flavor modulating amount, a sweet flavoring agent amount, a sweet flavor enhancing amount, or a therapeutically effective amount of one or more of the present compounds will be added to the ingestible composition, optionally in the presence of sweeteners so that the sweet flavor modified ingestible composition has an increased sweet taste as compared to the ingestible composition prepared without the compounds of the present invention, as judged by human beings or animals in general, or in the case of formulations testing, as judged by a majority of a panel of at least eight human taste testers, via procedures commonly known in the field.

In some embodiments, compounds as disclosed and described herein, individually or in combination, modulate the sweet taste or other taste properties of other natural or synthetic sweet tastants, and ingestible compositions made therefrom. In one embodiment, the compounds as disclosed and described herein, individually or in combination, may be used or provided in its ligand enhancing concentration(s). For example, the compounds as disclosed and described herein, individually or in combination, may be present in an amount of from 0.001 ppm to 100 ppm, or narrower alternative ranges from 0.1 ppm to 50 ppm, from 0.01 ppm to 40 ppm, from 0.05 ppm to 30 ppm, from 0.01 ppm to 25 ppm, or from 0.1 ppm to 30 ppm, or from 0.1 ppm to 25 ppm, or from 1 ppm to 30 ppm, or from 1 ppm to 25 ppm.

In some embodiments, flavor-modifying compounds as disclosed and described herein, individually or in combination, may be provided in a flavoring concentrate formulation, e.g., suitable for subsequent processing to produce a ready-to-use (i.e., ready-to-serve) product. By “a flavoring concentrate formulation”, it is meant a formulation which should be reconstituted with one or more diluting medium to become a ready-to-use composition. The term “ready-to-use composition” is used herein interchangeably with “ingestible composition”, which denotes any substance that, either alone or together with another substance, can be taken by mouth whether intended for consumption or not. In one embodiment, the ready-to-use composition includes a composition that can be directly

consumed by a human or animal. The flavoring concentrate formulation is typically used by mixing with or diluted by one or more diluting medium, e.g., any consumable or ingestible ingredient or product, to impart or modify one or more flavors to the diluting medium. Such a use process is often referred to as reconstitution. The reconstitution can be conducted in a household setting or an industrial setting. For example, a frozen fruit juice concentrate can be reconstituted with water or other aqueous medium by a consumer in a kitchen to obtain the ready-to-use fruit juice beverage. In another example, a soft drink syrup concentrate can be reconstituted with water or other aqueous medium by a manufacturer in large industrial scales to produce the ready-to-use soft drinks. Since the flavoring concentrate formulation has the flavoring agent or flavor modifying agent in a concentration higher than the ready-to-use composition, the flavoring concentrate formulation is typically not suitable for being consumed directly without reconstitution. There are many benefits of using and producing a flavoring concentrate formulation. For example, one benefit is the reduction in weight and volume for transportation as the flavoring concentrate formulation can be reconstituted at the time of usage by the addition of suitable solvent, solid or liquid.

The flavored products set forth according to any of the foregoing embodiments, also include, in certain embodiments, one or more additional flavor-modifying compounds, such as compounds that enhance sweetness (e.g., hesperetin, naringenin, glucosylated steviol glycosides, etc.), compounds that block bitterness, compounds that enhance umami, compounds that reduce sourness, compounds that enhance saltiness, compounds that enhance a cooling effect, or any combinations of the foregoing.

In certain embodiments of any aspects and embodiments set forth herein that refer to a sweetening or flavoring concentrate, the sweetening or flavoring concentrate is a non-naturally-occurring product, such as a composition specifically manufactured for the production of a flavored product, such as food or beverage product.

In one embodiment, the flavoring concentrate formulation comprises i) compounds as disclosed and described herein, individually or in combination; ii) a carrier; and iii) optionally at least one adjuvant. The term “carrier” denotes a usually inactive accessory substance, such as solvents, binders, or other inert medium, which is used in combination with the present compound and one or more optional adjuvants to form the formulation. For example, water or starch can be a carrier for a flavoring concentrate formulation. In some embodiments, the carrier is the same as the diluting medium for reconstituting the flavoring concentrate formulation; and in other embodiments, the carrier is different from the diluting medium. The term “carrier” as used herein includes, but is not limited to, ingestibly acceptable carrier.

The term “adjuvant” denotes an additive which supplements, stabilizes, maintains, or enhances the intended function or effectiveness of the active ingredient, such as the compound of the present invention. In one embodiment, the at least one adjuvant comprises one or more flavoring agents. The flavoring agent may be of any flavor known to one skilled in the art or consumers, such as the flavor of chocolate, coffee, tea, mocha, French vanilla, peanut butter, chai, or combinations thereof. In another embodiment, the at least one adjuvant comprises one or more sweeteners. The one or more sweeteners can be any of the sweeteners described in this application. In another embodiment, the at least one adjuvant comprises one or more ingredients selected from the group consisting of a emulsifier, a stabilizer, an antimicrobial preservative, an antioxidant, vitamins, minerals, fats, starches, protein concentrates and isolates, salts, and combinations thereof. Examples of emulsifiers, stabilizers, antimicrobial preservatives, antioxidants, vitamins, minerals, fats, starches, protein concentrates and isolates, and salts are described in U.S. Pat. No. 6,468,576, the content of which is hereby incorporated by reference in its entirety for all purposes.

In one embodiment, the present flavoring concentrate formulation can be in a form selected from the group consisting of liquid including solution and suspension, solid, foamy material, paste, gel, cream, and a combination thereof, such as a liquid containing certain amount of solid contents. In one embodiment, the flavoring concentrate formulation is in form of a liquid including aqueous-based and nonaqueous-based. In some embodiments, the present flavoring concentrate formulation can be carbonated or non-carbonated.

The flavoring concentrate formulation may further comprise a freezing point depressant, nucleating agent, or both as the at least one adjuvant. The freezing point depressant is an ingestibly acceptable compound or agent which can depress the freezing point of a liquid or solvent to which the compound or agent is added. That is, a liquid or solution containing the freezing point depressant has a lower freezing point than the liquid or solvent without the freezing point depressant. In addition to depress the onset freezing point, the freezing point depressant may also lower the water activity of the flavoring concentrate formulation. The examples of the freezing point depressant include, but are not limited to, carbohydrates, oils, ethyl alcohol, polyol, e.g., glycerol, and combinations thereof. The nucleating agent denotes an ingestibly acceptable compound or agent which is able to facilitate nucleation. The presence of nucleating agent in the flavoring concentrate formulation can improve the mouthfeel of the frozen Blushes of a frozen slush and to help maintain the physical properties and performance of the slush at freezing temperatures by increasing the number of desirable ice crystallization centers. Examples of nucleating agents

include, but are not limited to, calcium silicate, calcium carbonate, titanium dioxide, and combinations thereof.

5 In one embodiment, the flavoring concentrate formulation is formulated to have a low water activity for extended shelf life. Water activity is the ratio of the vapor pressure of water in a formulation to the vapor pressure of pure water at the same temperature. In one embodiment, the flavoring concentrate formulation has a water activity of less than about 0.85. In another embodiment, the flavoring concentrate formulation has a water activity of less than about 0.80. In another embodiment, the flavoring concentrate formulation has a water activity of less than about 0.75.

10 In one embodiment, the flavoring concentrate formulation has the present compound in a concentration that is at least 2 times of the concentration of the compound in a ready-to-use composition. In one embodiment, the flavoring concentrate formulation has the present compound in a concentration that is at least 5 times of the concentration of the compound in a ready-to-use composition. In one embodiment, the flavoring concentrate formulation has the
15 present compound in a concentration that is at least 10 times of the concentration of the compound in a ready-to-use composition. In one embodiment, the flavoring concentrate formulation has the present compound in a concentration that is at least 15 times of the concentration of the compound in a ready-to-use composition. In one embodiment, the flavoring concentrate formulation has the present compound in a concentration that is at least
20 20 times of the concentration of the compound in a ready-to-use composition. In one embodiment, the flavoring concentrate formulation has the present compound in a concentration that is at least 30 times of the concentration of the compound in a ready-to-use composition. In one embodiment, the flavoring concentrate formulation has the present compound in a concentration that is at least 40 times of the concentration of the compound in
25 a ready-to-use composition. In one embodiment, the flavoring concentrate formulation has the present compound in a concentration that is at least 50 times of the concentration of the compound in a ready-to-use composition. In one embodiment, the flavoring concentrate formulation has the present compound in a concentration that is at least 60 times of the concentration of the compound in a ready-to-use composition. In one embodiment, the
30 flavoring concentrate formulation has the present compound in a concentration that is up to 100 times of the concentration of the compound in a ready-to-use composition.

The sweetening or flavoring concentrates set forth according to any of the foregoing embodiments, also include, in certain embodiments, one or more additional flavor-modifying compounds, such as compounds that enhance sweetness (e.g., hesperetin, naringenin,

- glucosylated steviol glycosides, etc.), compounds that block bitterness (e.g., eriodictyol, homoeriodictyol, sterubin, and salts or glycoside derivatives thereof, as well as vanillyl lignans, e.g., matairesinol and other compounds set forth in PCT Publication No. WO 2012/146584), compounds that enhance umami (e.g., rubemamine, rubescenamine, (E)-3-(3,4-dimethoxyphenyl)-N-(4-methoxyphenethyl)acrylamide, and the like), compounds that reduce sourness and/or licorice taste, compounds that enhance saltiness, compounds that enhance a cooling effect, or any combinations of the foregoing.

Tabletop Compositions

- In some further aspects, the disclosure provides a tabletop sweetener composition comprising: (a) at least one sweetener composition, which, in addition to comprising a sweetener (according to any of the preceding aspects and embodiments thereof) also comprises the active compound, or a comestibly acceptable salt thereof; and (b) at least one bulking agent.

- The tabletop sweetener composition may take any suitable form including, but not limited to, an amorphous solid, a crystal, a powder, a tablet, a liquid, a cube, a glaze or coating, a granulated product, an encapsulated form bound to or coated on to carriers/particles, wet or dried, or combinations thereof.

- The tabletop sweetener composition may contain further additives known to those skilled in the art. These additives include but are not limited to bubble forming agents, bulking agents, carriers, fibers, sugar alcohols, oligosaccharides, sugars, high intensity sweeteners, nutritive sweeteners, flavorings, flavor enhancers, flavor stabilizers, acidulants, anti-caking and free-flow agents. Such additives are for example described by H. Mitchell (H. Mitchell, "Sweeteners and Sugar Alternatives in Food Technology", Blackwell Publishing Ltd, 2006, which is incorporated herein by reference in its entirety). As used herein, the term "flavorings" may include those flavors known to the skilled person, such as natural and artificial flavors. These flavorings may be chosen from synthetic flavor oils and flavoring aromatics and/or oils, oleoresins and extracts derived from plants, leaves, flowers, fruits, and so forth, and combinations thereof. Non-limiting representative flavor oils include spearmint oil, cinnamon oil, oil of wintergreen (methyl salicylate), peppermint oil, Japanese mint oil, clove oil, bay oil, anise oil, eucalyptus oil, thyme oil, cedar leaf oil, oil of nutmeg, allspice, oil of sage, mace, oil of bitter almonds, and cassia oil. Also useful flavorings are artificial, natural and synthetic fruit flavors such as vanilla, and citrus oils including lemon, orange, lime, grapefruit, yuzu, sudachi, and fruit essences including apple, pear, peach, grape,

blueberry, strawberry, raspberry, cherry, plum, pineapple, watermelon, apricot, banana, melon, apricot, ume, cherry, raspberry, blackberry, tropical fruit, mango, mangosteen, pomegranate, papaya and so forth. Other potential flavors include a milk flavor, a butter flavor, a cheese flavor, a cream flavor, and a yogurt flavor; a vanilla flavor; tea or coffee

5 flavors, such as a green tea flavor, a oolong tea flavor, a tea flavor, a cocoa flavor, a chocolate flavor, and a coffee flavor; mint flavors, such as a peppermint flavor, a spearmint flavor, and a Japanese mint flavor; spicy flavors, such as an asafetida flavor, an ajowan flavor, an anise flavor, an angelica flavor, a fennel flavor, an allspice flavor, a cinnamon flavor, a camomile flavor, a mustard flavor, a cardamom flavor, a caraway flavor, a cumin

10 flavor, a clove flavor, a pepper flavor, a coriander flavor, a sassafras flavor, a savory flavor, a Zanthoxyl Fructus flavor, a perilla flavor, a juniper berry flavor, a ginger flavor, a star anise flavor, a horseradish flavor, a thyme flavor, a tarragon flavor, a dill flavor, a capsicum flavor, a nutmeg flavor, a basil flavor, a marjoram flavor, a rosemary flavor, a bayleaf flavor, and a wasabi (Japanese horseradish) flavor; alcoholic flavors, such as a wine flavor, a whisky

15 flavor, a brandy flavor, a rum flavor, a gin flavor, and a liqueur flavor; floral flavors; and vegetable flavors, such as an onion flavor, a garlic flavor, a cabbage flavor, a carrot flavor, a celery flavor, mushroom flavor, and a tomato flavor. These flavoring agents may be used in liquid or solid form and may be used individually or in admixture. Commonly used flavors include mints such as peppermint, menthol, spearmint, artificial vanilla, cinnamon

20 derivatives, and various fruit flavors, whether employed individually or in admixture. Flavors may also provide breath freshening properties, particularly the mint flavors when used in combination with cooling agents.

Flavors may also provide breath freshening properties, particularly the mint flavors when used in combination with cooling agents. These flavorings may be used in liquid or

25 solid form and may be used individually or in admixture. Other useful flavorings include aldehydes and esters such as cinnamyl acetate, cinnamaldehyde, citral diethylacetal, dihydrocarvyl acetate, eugenyl formate, p- methylamisol, and so forth may be used. Generally any flavoring or food additive such as those described in Chemicals Used in Food Processing, publication 1274, pages 63-258, by the National Academy of Sciences, may be

30 used. This publication is incorporated herein by reference.

Further examples of aldehyde flavorings include but are not limited to acetaldehyde (apple), benzaldehyde (cherry, almond), anisic aldehyde (licorice, anise), cinnamic aldehyde (cinnamon), citral, i.e., alpha-citral (lemon, lime), neral, i.e., beta-citral (lemon, lime), decanal (orange, lemon), ethyl vanillin (vanilla, cream), heliotrope, i.e., piperonal (vanilla,

cream), vanillin (vanilla, cream), alpha-amyl cinnamaldehyde (spicy fruity flavors), butyraldehyde (butter, cheese), valeraldehyde (butter, cheese), citronellal (modifies, many types), decanal (citrus fruits), aldehyde C-8 (citrus fruits), aldehyde C-9 (citrus fruits), aldehyde C-12 (citrus fruits), 2-ethyl butyraldehyde (berry fruits), hexenal, i.e., trans-2 (berry
5 fruits), tolyl aldehyde (cherry, almond), veratraldehyde (vanilla), 2,6- dimethyl-5-heptenal, i.e., melonal (melon), 2,6-dimethyloctanal (green fruit), and 2- dodecenal (citrus, mandarin), cherry, grape, strawberry shortcake, and mixtures thereof. These listings of flavorings are merely exemplary and are not meant to limit either the term "flavoring" or the scope of the disclosure generally.

10 In some embodiments, the flavoring may be employed in either liquid form and/or dried form. When employed in the latter form, suitable drying means such as spray drying the oil may be used. Alternatively, the flavoring may be absorbed onto water soluble materials, such as cellulose, starch, sugar, maltodextrin, gum arabic and so forth or may be encapsulated. The actual techniques for preparing such dried forms are well-known.

15 In some embodiments, the tabletop sweetener can be made to be similar to brown sugar. In such embodiments, compounds imparting brown notes can be added to the composition to make it taste more similar to brown sugar.

In some embodiments, the flavorings may be used in many distinct physical forms well- known in the art to provide an initial burst of flavor and/or a prolonged sensation of
20 flavor. Without being limited thereto, such physical forms include free forms, such as spray dried, powdered, beaded forms, encapsulated forms, and mixtures thereof.

Suitable bulking agents include, but are not limited to maltodextrin (10 DE, 18 DE, or 5 DE), corn syrup solids (20 or 36 DE), sucrose, fructose, glucose, invert sugar, sorbitol, xylose, ribulose, mannose, xylitol, mannitol, galactitol, erythritol, maltitol, lactitol, isomalt,
25 maltose, tagatose, lactose, inulin, glycerol, propylene glycol, polyols, polydextrose, fructooligosaccharides, cellulose and cellulose derivatives, and the like, and mixtures thereof. Additionally, granulated sugar (sucrose) or other caloric sweeteners such as crystalline fructose, other carbohydrates, or sugar alcohols can be used as a bulking agent due to their provision of good content uniformity without the addition of significant calories.

30 In one embodiment, the at least one bulking agent may be a bulking agent described in U.S. Patent No. 8,993,027.

In one embodiment, the at least one bulking agent may be a bulking agent described in U.S. Patent No. 6,607,771.

In one embodiment, the at least one bulking agent may be a bulking agent described in U.S. Patent No. 6,932,982.

In some embodiments, the tabletop sweetener composition may further comprise at least one anti-caking agent. As used herein the phrase "anti-caking agent" and "flow agent" refer to any composition which prevents, reduces, inhibits, or suppresses the at least one sweetener from attaching, binding, or contacting to another sweetener molecule. Alternatively, anti-caking agent may refer to any composition which assists in content uniformity and uniform dissolution. Non-limiting examples of anti-caking agents include cream of tartar, calcium silicate, silicon dioxide, microcrystalline cellulose (Avicel, FMC BioPolymer, Philadelphia, Pa.), and tricalcium phosphate. In one embodiment, the anti-caking agents are present in the tabletop sweetener composition in an amount from about 0.001 to about 3% by weight of the tabletop sweetener composition.

In some embodiments, the sweetener compositions of any of the preceding aspects and embodiments thereof are encapsulated using typical means for encapsulating flavor or fragrance compounds. Non-limiting examples of such technology are set forth in U.S. Patent Application Publication Nos. 2016/0235102, 2019/0082727, 2018/0369777, 2018/0103667, 2016/0346752, 2015/0164117, 2014/0056836, 2012/0027866, 2010/0172945, and 2007/0128234, as well as U.S. Patent Nos. 7,488,503, 6,416,799, 5,897,897, 5,786,017, 5,603,971, 4,689,235, 4,610,890, 3,704,137, 3,041,180, and 2,809,895. All of the preceding patent publications and patents are hereby incorporated by reference as though set forth herein in their entireties.

Non-Animal Protein Materials and Products Made Therefrom

Products intended to replace or substitute meat or dairy products often rely on various non-animal-based materials, such as starches and proteins derived from plants, algae, and fungi, to simulate the texture and flavor of meat or dairy. Non-limiting examples of such plant proteins include soy proteins, pea proteins, bean proteins, grain proteins, and the like. Due to compositional differences between such plant-based materials and animal-derived materials, such as a lack of glutamate-containing proteins and glutathione, these products can lack the umami and/or kokumi taste that consumers traditionally associate with meat or dairy products.

Thus, in certain aspects, the disclosure provides a flavored product comprising a plant-based material (such as a plant-based starch, a plant-based protein, or a combination thereof) and the active compound, or a comestibly acceptable salt thereof. In some further

embodiments, the flavored product can include any features of combination of features set forth above for ingestible compositions that contain the active compound, or a comestibly acceptable salt thereof. In some embodiments, the flavored product is a beverage, such as soy milk, almond milk, rice milk, oat milk, a protein drink, a meal-replacement drink, or other like product. In some other embodiments, the flavored product is a meat-replacement product, such as a plant-based chicken product (such as a plant-based chicken nugget), a plant-based beef product (such as a plant-based burger), and the like. In some other embodiments, the flavored product is a protein powder, a meal-replacement powder, a plant-based creamer for coffee or tea, and the like. In certain further embodiments, any such products contain additional ingredients, and have additional features, as are typically used in the preparation and/or manufacture of such products. For example, such the active compound, or comestibly acceptable salts thereof, may be combined with other flavors and taste modifiers, and may even be encapsulated in certain materials, according to known technologies in the relevant art. Suitable concentrations of the active compound, or comestibly acceptable salts thereof, are set forth above.

In some further embodiments analogous to the above embodiments, proteins or starches from algal or fungal sources can be used instead of or in combination with plant starches or proteins.

Non-Meat Protein Materials and Products Made Therefrom

Certain non-meat animal proteins, such as dairy proteins and proteins from bone broth, are commonly used in food products, and are also sold as the primary ingredient in certain protein powders. Such proteins can impart flavors that lack the full umami or kokumi taste that consumers may desire. This is especially true for protein isolates, such as protein isolates of whey protein, collagen protein, casein proteins, and the like. Thus, the present disclosure provides ingestible compositions that include non-meat animal proteins and the active compound, or a comestibly acceptable salt thereof. The active compound, or its comestibly acceptable salts, can be present in any suitable combination, according to the embodiments set forth in the preceding sections of the present disclosure. In some embodiments, the non-meat animal protein is a bone protein, such as a collagen protein derived from the bones of an animal, such as a cow, pig, donkey, horse, chicken, duck, goat, goose, rabbit, lamb, sheep, buffalo, ostrich, camel, and the like. In some embodiments, the non-meat animal protein is a milk protein, such as a whey protein, a casein protein, or any

combination thereof. The milk can be the milk of any suitable animal, such as a cow, donkey, horse, sheep, buffalo, camel, and the like.

The active compound, or its comestibly acceptable salts, can also be included in certain food or beverage products that include animal milk or materials derived from animal milk. Such products include cheeses, cheese spreads, yogurt, kefir, milk, processed dairy products, cottage cheese, sour cream, butter, and the like.

EXAMPLES

To further illustrate this invention, the following examples are included. The examples should not, of course, be construed as specifically limiting the invention. Variations of these examples within the scope of the claims are within the purview of one skilled in the art and are considered to fall within the scope of the invention as described, and claimed herein. The reader will recognize that the skilled artisan, armed with the present disclosure, and skill in the art is able to prepare and use the invention without exhaustive examples.

Example 1 – Assays

To implement the identification of hT1R1-TMD modulators, cells transiently or stably expressing hT1R1 (T1R1) in the presence of hT1R3 (T1R3) are stimulated with library compounds. Similarly, the same compounds are screened in a GTP γ S binding assay utilizing membranes expressing transmembrane domain (TMD) of hT1R1 as described in Zhang et al., Proc. Nat'l Acad. Sci., vol. 105, pp. 20930-20934 (2008). Compounds active exclusively active in the two assays are then prioritized and evaluated in sensory for the detection of an umami note on their own and synergy in the presence of MSG or MSG + IMP.

Example 2 – Test Compound

The compound *N*-(heptan-4-yl)-benzo[d][1,3]dioxole-5-carboxamide (S807) was used as a test compound in a T1R1/T1R3 assay, both alone and in the presence of monosodium glutamate (MSG). FIG. 2 shows the agonist activity for S807 on T1R1/T1R3 as well as its enhancement properties on the MSG effect on also measured on T1R1/T1R3.

In a similar way, the T1R1/T1R3 assay was used to measure the activity of monosodium glutamate (MSG), inosine 5' monophosphate (IMP), S807, MSG+IMP, S807+MSG, S807+IMP, and S807+MSG+IMP. FIG. 3 shows the percent activity of each of the tests. The results indicate that TMD modulators, such as S807, show a synergistic effect with MSG and with the combination of MSG and IMP.

Example 3 – Sensory Testing

- Sixteen (16) panelists using two (2) reps were asked to select whether a 16 mM solution of MSG or a 4 ppm solution of S807 had a greater umami taste. Of the 32 selections, 19 favored the MSG solution and 13 favored the S807 solution. Based on the
- 5 sample size, the results indicate no statistically significant preference for MSG versus S807.

CLAIMS

1. A method of identifying compounds that produces or enhances an umami taste, the method comprising:
- 5 (a1) introducing a test compound to a first taste receptor, wherein the taste receptor is a polypeptide that comprises a polypeptide sequence of SEQ ID NO: 2, a functional fragment thereof, or a polypeptide sequence whose sequence is at least 90% equivalent to either of the foregoing;
- (a2) measuring a first response of the first taste receptor to the test compound by
- 10 comparing an activity of the taste receptor in the presence and the absence of the test compound;
- (b1) introducing the test compound to a second taste receptor, which comprises a first subunit and a second subunit, wherein the first subunit is a polypeptide that comprises a polypeptide sequence of SEQ ID NO: 1, functional fragments thereof, or polypeptide
- 15 sequences whose sequences are at least 90% equivalent to either of the foregoing, and the second subunit is a polypeptide that comprises a polypeptide sequence of SEQ ID NO: 3, functional fragments thereof, or polypeptide sequences whose sequences are at least 90% equivalent to either of the foregoing, or the second subunit is a polypeptide that comprises a polypeptide sequence of SEQ ID NO: 4, functional fragments thereof, or polypeptide
- 20 sequences whose sequences are at least 90% equivalent to either of the foregoing; and
- (b2) measuring a second response of the second taste receptor to the test compound by comparing an activity of the second taste receptor in the presence and the absence of the test compound.
- 25 2. A method of claim 1, further comprising (c) identifying an active test compound that produces or enhances umami taste based on the measured first response and the measured second response.
3. A method of claim 2, further comprising (d) selecting the active test compound as a
- 30 compound that produces or enhances umami taste.
4. The method of any one of claims 1 to 3, wherein the introducing steps (a1) and (b1) comprise introducing the test compound to the first taste receptor or the second taste receptor

in the presence of an umami compound, such as a compound that imparts or enhances umami taste.

- 5 5. The method of claim 4, wherein the umami compound is a glutamate (such as monosodium glutamate (MSG)), an aspartate, a purinic ribonucleotide (such as inosine monophosphate (IMP) or guanosine monophosphate (GMP)), or any combination thereof.
6. The method of any one of claims 1 to 65 wherein the test compound is a naturally occurring compound or a glycosylated or deglycosylated derivative thereof.
- 10 7. The method of any one of claims 1 to 6, wherein the test compound is a non-naturally occurring compound.
8. Use of a flavor modifying composition for imparting or enhancing an umami taste in an ingestible composition, the flavor-modifying composition comprising the identified or selected compound of any one of claims 2 to 7.
- 15 9. The use of claim 8, wherein the flavor-modifying composition further comprises a bitter blocking compound, a mouthfeel enhancer, a sweetener, a sweetness enhancer, or any combination thereof.
- 20 10. The use of claim 8 or 9, wherein the ingestible composition comprises a plant-based material, such as a plant-based starch, a plant-based protein, or any combination thereof.
- 25 11. The use of claim 10, wherein the plant based material comprises a plant-based protein.
12. The use of claim 11, wherein the plant-based protein makes up at least 20% by weight, or at least 30% by weight, or at least 40% by weight, or at least 50% by weight, or at least 60% by weight, or at least 70% by weight, of the ingestible composition, on a dry weight basis.
- 30 13. The use of any one of claims 10 to 12, wherein the plant-based protein is soy protein, chickpea protein, pea protein, bean protein, or any combination thereof.

14. The use of any one of claims 8 to 13, wherein the ingestible composition is a food product, such as a plant-based meat analogue product.

15. Use of a flavor-modifying compound to (a) reduce an amount of monosodium glutamate in an ingestible composition, (b) reduce an amount of sodium in an ingestible composition, (c) reduce an amount of fat in an ingestible composition, (d) reduce an amount of animal products in an ingestible composition, or (e) reduce an amount of alcohol in an ingestible composition, without reducing an umami taste of the flavored product, wherein the flavor-modifying compound is the active compound of any one of claims 2 to 7.

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16. The use of claim 15, wherein the flavor-modifying compound reduces the amount of monosodium glutamate, sodium, fat, animal products, or alcohol by at least 20%, or at least 25%, or at least 30%, or by at least 40%, or by at least 50%, or at least 60%, or at least 70%, or at least 80%, or at least 90%.

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17. The use of claim 15 or 16, wherein the ingestible composition further comprises a bitter blocking compound, a mouthfeel enhancer, a sweetener, a sweetness enhancer, or any combination thereof.

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18. The use of any one of claims 15 to 17, wherein the ingestible composition comprises a plant-based material, wherein the plant-based material comprises a plant-based starch, a plant-based protein, or any combination thereof.

19. The use of claim 18, wherein the plant based material comprises a plant-based protein.

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20. The use of claim 19, wherein the plant-based protein makes up at least 20% by weight, or at least 30% by weight, or at least 40% by weight, or at least 50% by weight, or at least 60% by weight, or at least 70% by weight, of the ingestible composition, on a dry weight basis.

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21. The use of any one of claims 18 to 20, wherein the plant-based protein is soy protein, chickpea protein, pea protein, bean protein, or any combination thereof.

22. The use of any one of claims 15 to 21, wherein the ingestible composition is a food product, such as a plant-based meat analogue product.