

**IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE**

IMPOSSIBLE FOODS INC.,	)	
	)	
Plaintiff,	)	
	)	
v.	)	C.A. No. 22-311 (WCB)
	)	
MOTIF FOODWORKS, INC.,	)	
	)	
Defendant.	)	

**DECLARATION OF DR. ROBERT MCGORRIN
IN SUPPORT OF MOTIF’S ANSWERING CLAIM CONSTRUCTION BRIEF**

I, Robert McGorin, Ph.D., declare as follows:

1. I have been retained by Quinn Emanuel Urquhart & Sullivan LLP on behalf of Defendant Motif FoodWorks, Inc. (“Motif”) as an independent expert in the litigation captioned above (“Litigation”). It is my understanding that this litigation is currently pending before the United States District Court for the District of Delaware. I understand that the parties are presently engaging in claim construction proceedings in the Litigation. I have been asked to provide this declaration in support of certain positions advanced by Motif in these claim construction proceedings (“Declaration”).

2. I understand that, in this Litigation, Motif is offering constructions of certain terms, including terms in claims 1-3 of U.S. Patent No. 9,943,096 (the “’096 patent”), claims 14 and 27 of U.S. Patent No. 10,039,306 (the “’306 patent”), claims 1 and 12 of U.S. Patent No. 10,863,761 (the “’761 patent”), claims 1 and 13 of U.S. Patent No. 11,013,250 (the “’250 patent”), and claims 1, 7, and 22-23 of U.S. Patent No. 11,224,241 (the “’241 patent”) (“Foodstuff Claims” and “Foodstuff Patents”). Based on my review of the first page of these patents, I understand them to be assigned to Impossible Foods Inc. (“Plaintiff”).

3. As explained in greater detail below, I have been asked to describe relevant technical principles and literature and the state of the art regarding certain terms recited in the Foodstuff Claims. I have also been asked to provide my opinions regarding the meaning of such terms as they would have been understood by a person of ordinary skill in the art for the Foodstuff Patents (*i.e.*, a “POSITA,” which I define below).

4. I reserve the right to amend or supplement my opinions in this Declaration in response to any positions that Plaintiff or its experts may take in the claim construction proceedings, the Litigation, or in response to any order of the District Court.

I. QUALIFICATIONS AND EXPERTISE

5. Exhibit M1 to this Declaration is a true and correct copy of my current CV. It describes in greater detail my education, publications, employment and research history, and professional activities and awards.

6. I am presently a Professor of Flavor Chemistry in the Food Science & Technology Department at Oregon State University. I received a B.A. in Chemistry from Northwestern University in 1973, an M.S. in Organic/Medicinal Chemistry from the University of Illinois in 1976 and a Ph.D. in Organic/Medicinal Chemistry from the University of Illinois in 1980.

7. I am a nationally and internationally recognized expert and scholar in the field of flavor science, and have been actively involved in flavor research for more than 44 years. I have organized/co-organized eight flavor chemistry symposia and presented more than 15 invited symposium talks, and over 65 papers at national and international scientific conferences. My expertise is in the area of flavor chemistry, flavor technology, flavor analysis, and the chemistry and interactions among flavor and food components. This expertise is the result of my combined academic/food industry career as a professor at Oregon State University in Food Science with a specialty in Flavor Chemistry (2000-present), a senior research scientist and section manager of the flavor group while at Kraft Foods, Inc. Research & Development (1981-2000), and a researcher on Maillard reactions and oat cereal flavor chemistry while employed as a research scientist in the flavor technology department at Quaker Oats Company Research & Development (1978-1981).

8. I have authored and co-authored numerous peer-reviewed scientific publications and technical book chapters relating to flavor chemistry, Maillard reactions, oat cereal chemistry, dairy flavors, and flavor-food interactions including but not limited to publications in well-respected scientific journals such as the *Journal of Agricultural and Food Chemistry*, *Analytical Chemistry*, *Journal of Food Science*, *LWT—Food Science and Technology*, and book chapters in

the American Chemical Society Symposium Series. In addition, I have co-edited four books on flavor chemistry, two of which particularly involve Maillard reactions of heating foods such as meat to produce cooked beef flavors and aromas: T. H. Parliment, M. J. Morello, and R. J. McGorin, Eds. *Thermally Generated Flavors: Maillard, Microwave, and Extrusion Processes*, ACS Books, Washington, D.C., American Chemical Society Symposium Series 543, 1994; T. H. Parliment, R. J. McGorin, and C.-T. Ho, Eds. *Thermal Generation of Aromas*, ACS Books, Washington, D.C., ACS Symposium Series 409, 1989. I have published three chapters in flavor chemistry books about the subject of key impact flavor chemicals, also known as character-impact flavor compounds in foods, including Maillard-type, brown, and meat flavors, a most recent example is: McGorin, R. J., Character-impact flavor and off-flavor compounds in foods. In *Flavor, Fragrance, and Odor Analysis*, 2nd. ed, R. Marsili, Ed., CRC Press, Boca Raton, FL, 2012, Chapter 9, pp. 207-262. I also wrote a review chapter in a flavor chemistry reference book that described the occurrence of sulfur-containing flavor compounds in cooked beef and meat that are produced by Maillard reactions: McGorin, R. J., The significance of volatile sulfur compounds in food flavors, In *Volatile Sulfur Compounds in Food*, M. C. Qian, X. Fan, and K. Mahattanatawee, Eds., ACS Symposium Series 1068, ACS Books, Washington, D.C., 2011, Chapter 1, pp. 3-31. These publications are included in my *curriculum vitae* which is attached as Exhibit M1.

9. During my industrial career I received formal training and Flavor Profile certificates in the sensory descriptive analysis methods by Arthur D. Little (Boston, MA) and Sensory Spectrum (New Providence, NJ).

10. I have served on editorial boards for respected peer reviewed journals in the fields of food science, flavor science, and chemistry: *Journal of Agricultural and Food Chemistry* (24 years), *Chemosensory Perception* (15 years) and *Chemical Innovation* (5 years).

11. My professional achievements in flavor chemistry have been recognized by international scientific organizations. I am an elected Fellow of both the Institute of Food Technologists and the American Chemical Society. I received the Distinguished Service Award in Agricultural and Food Chemistry from the American Chemical Society, and am a recipient of two Kraft Foods ABCD (Above and Beyond the Call of Duty) Awards. I am a Certified Food Scientist as conferred by the International Food Science Certification Commission.

12. In my extensive involvement in professional societies, I am a member of the Executive board and the Past-Chair and Program Chair of the American Chemical Society (ACS) Division of Agricultural & Food Chemistry (AGFD), served as the Chair of the ACS AGFD Flavor Chemistry Subdivision, am a professional member of the Institute of Food Technologists (IFT) and Past-Chairs of both the IFT Higher Education Review Board and the IFT Council of Food Science Administrators.

13. I frequently peer-review grant proposals submitted to the United States Department of Agriculture (USDA) and food commodity commissions, relating to research in the field of food and agriculture and topics including Maillard-generated flavors, and have served twice as a USDA panel manager for reviewing research proposals on Improving Food Quality.

II. SCOPE OF ASSIGNMENT

14. I have reviewed the Foodstuff Patents as well as prosecution records of these patents. I have been asked to discuss principles of meat flavor chemistry and their application in food science, particularly relating to the chemistry of meat flavor and the preparation of meat replica products and meat flavor additives. In this Declaration, I comment on certain relevant patents and technical literature. I also draw upon my 44 years of experience in the field of food science and flavor chemistry.

15. I have been asked to opine on how a POSITA would understand certain terms recited in the claims of the Foodstuff Patents. I summarize these terms in the charts below, which reflect how these terms are recited in the independent claims of the Foodstuff Patents.

16. The terms in the first chart generally cover two categories of molecules—sugar molecules (including specific sugars) and sulfur-containing molecules, such as certain amino acids. Notably, each Foodstuff Claim recites both a sugar molecule term and a sulfur molecule term. The food flavor art long recognized that the combination of these two categories of molecules could produce volatile compounds characteristic of meat aromas, as I explain in greater detail in Section V below. For ease of reference, I refer to these terms collectively as the “Compound Terms.”

Claim	Sugar Compound Term	Sulfur Compound Term
'306 patent claim 1, 14, 27	a sugar selected from glucose, ribose, sucrose, fructose, xylose, maltodextrin, and combinations thereof	at least one sulfur compound selected from methionine, cysteine and thiamine
'250 patent claim 1, 13	a sugar selected from glucose, ribose, sucrose, fructose, xylose, maltodextrin, and combinations thereof	at least one sulfur compound selected from methionine, cysteine, and thiamine
'096 patent claim 1, 10	a compound selected from glucose, ribose, fructose, lactose, xylose, arabinose, glucose-6-phosphate, maltose, maltodextrin, and galactose, and mixtures of two or more thereof	a compound selected from cysteine, cystine, thiamine, methionine, and mixtures of two or more thereof
'241 patent claim 1	a compound selected from glucose, ribose, fructose, lactose, xylose, arabinose, glucose-6-phosphate, maltose, and galactose, and mixtures of two or more thereof	a compound selected from cysteine, cystine, thiamine, methionine, and mixtures of two or more thereof

Claim	Sugar Compound Term	Sulfur Compound Term
'241 patent claim 22	one or more of glucose, ribose, fructose, lactose, xylose, arabinose, glucose-6-phosphate, maltose, and galactose	one or more of cysteine, cystine, thiamine, and methionine
'761 patent claim 1	at least one sugar compound	at least one sulfur compound

17. The limitation in the second chart also covers sulfur-containing molecules, but includes an additional term that identifies the concentration of the sulfur-containing molecules that are added to the '241 patent's meat-like-food product. As I explain in greater detail below, this limitation refers to the concentration of the sulfur-containing compounds in a liquid volume that is a starting ingredient that is added to the meat-like-food product. It does not refer to the concentration of the sulfur-containing compound in the product itself. For ease of reference, I refer to the term "in a concentration of at least 1.5 mM" as the "Molarity Term."

Claim	Limitation including Molarity Term
'241 patent claim 1	a compound selected from cysteine, cystine, thiamine, methionine, and mixtures of two or more thereof in a concentration of at least 1.5 mM

18. In connection with my preparation of this Declaration, I have reviewed a Joint Claim Construction Statement that I understand the Litigation parties prepared, and a redacted Claim Construction Brief that I understand was prepared by Plaintiff Impossible Foods. I reproduce a portion of the JCCS below, which I understand represents the parties' dispute regarding the Compound Terms and Molarity Term.

Plaintiff's Term No.	Claim Term	Plaintiff's Proposed Construction	Defendant's Term No.	Defendant's Proposed Construction
7.	"at least one sugar compound" ('761 patent, cl. 1)	Plain and ordinary meaning.	2.	"sugar compound added as a flavor precursor to said muscle replica"
8.	"a sugar selected from glucose, ribose, sucrose, fructose, xylose, maltodextrin, and combinations thereof" ('306 patent, cl. 14, 27; '250 patent, cl. 1, 13)	Plain and ordinary meaning.	2.	"glucose, ribose, sucrose, fructose, xylose, maltodextrin, or combinations thereof added as a flavor precursor to said meat replica matrix"
9.	"a compound selected from glucose, ribose, fructose, lactose, xylose, arabinose, glucose-6-phosphate, maltose, and galactose, and mixtures of two or more thereof"	Plain and ordinary meaning.	2.	"glucose, ribose, fructose, lactose, xylose, arabinose, glucose-6-phosphate, maltose, and galactose, or mixtures of two or more thereof added as a flavor precursor to said food flavor additive composition" ('096 Patent cl. 1, 14) "glucose, ribose, fructose, lactose, xylose, arabinose, glucose-6-phosphate, maltose, and galactose, or mixtures of two or more thereof added as a flavor precursor to said meat-like food product" ('241 Patent cl. 1)
	('096 patent, cl. 1; '241 patent, cl. 1)			
10.	"one or more of glucose, ribose, fructose, lactose, xylose, arabinose, glucose-6-phosphate, maltose, and galactose" ('241 patent, cl. 22)	Plain and ordinary meaning.	2.	"glucose, ribose, fructose, lactose, xylose, arabinose, glucose-6-phosphate, maltose, and/or galactose added as a flavor precursor to said meat-like-food product"
11.	"at least one sulfur compound" ('761 patent, cl. 1)	Plain and ordinary meaning.	2.	"at least one sulfur compound added as a flavor precursor to said muscle replica"
12.	"at least one sulfur compound selected from methionine, cysteine and thiamine" ('306 patent, cl. 14, 27; '250 patent, cl. 1, 13)	Plain and ordinary meaning.	2.	"methionine, cysteine, and/or thiamine added as a flavor precursor to said meat replica matrix"
13.	"a compound selected from cysteine, cystine, thiamine,	Plain and ordinary meaning.	2.	"cysteine, cystine, thiamine, methionine, or mixtures of two or more thereof added as a flavor precursor to said food flavor

	methionine, and mixtures of two or more thereof” ('096 patent, cl. 1; '241 patent, cl. 1)			additive composition” ('096 Patent cl. 1) “cysteine, cystine, thiamine, methionine, or mixtures of two or more thereof added as a flavor precursor to said meat-like-food product” ('241 Patent cl. 1)
14.	“one or more of cysteine, cystine, thiamine, and methionine” ('241 patent, cl. 22)	Plain and ordinary meaning.	2.	“cysteine, cystine, thiamine, and/or methionine added as a flavor precursor to said meat-like-food product”
21.	“a concentration of at least 1.5 mM” ('241 patent, cl. 1)	Plain and ordinary meaning with patentable weight for patentability purposes.	5.	“in a liquid composition having a concentration of at least 1.5 mM” No patentable weight for patentability purposes; only has patentable weight for infringement since a product by process claim.

19. I am informed by Motif’s counsel that Impossible contends that proteins in Motif’s food products practice the “Sulfur Compound Term” limitations of the Foodstuff Patents and the Molarity Term of the '241 patent.

III. SUMMARY OF OPINIONS

20. I agree with Motif’s proposed constructions for the Compound Terms. As I explain below, the food flavoring art recognized for many decades that the molecules recited in the Compound Terms were meat “flavor precursors.”

21. Motif’s proposal correctly reflects how a POSITA would understand the Compound Terms as they are used in the context of the Foodstuff Claims and in light of the Foodstuff Patents’ specifications and prosecution history. A POSITA would understand that the Compound Terms refer to small-molecule flavor precursors that are added to a replica product. More specifically, where the Compound Terms recite specific compounds (ribose, glucose, cysteine, methionine, and the like), a POSITA would understand that the terms refer to those free, stand-alone molecules, rather than their inclusion as part of a larger and more complex structure such as a protein. Indeed, a POSITA would understand that the Compound Terms refer to different

ingredients of a replica foodstuff than proteins such as plant proteins. The Foodstuff Patents describe that plant proteins in particular contribute to flavor in undesirable ways.

22. Moreover, a POSITA would understand from the patents that the Compound Term ingredients are added to the replica before it is cooked and does not refer to degradants caused by cooking proteins in the food.

23. Motif's proposal represents the true "plain and ordinary" meaning of the Compound Terms. Moreover, the patents' disclosure and intrinsic record is fully consistent with a POSITA's understanding of the well-known use of small-molecule sugar and sulfur-containing compounds in the art. A POSITA would therefore recognize that the Compound Term ingredients are different from the separately-claimed "plant protein" element of the claims.

24. I also agree with Motif's proposed construction of the term "in a concentration of at least 1.5 mM" ("Molarity Term") as meaning "in a liquid composition having a concentration of at least 1.5 mM."

25. Motif's proposal correctly reflects how a POSITA would understand the Molarity Term as it is used in the context of the Foodstuff Claims and in light of the Foodstuff Patents' specifications and prosecution history. In sum, a POSITA would understand that the Molarity Term specifies the molarity (i.e., molar concentration) of one ingredient in the claimed product, "a compound selected from cysteine, cystine, thiamine, methionine, and mixtures of two or more thereof" (referred to herein as the "sulfur compound"). A POSITA would further understand that specifying the concentration of the sulfur compound(s) in terms of molarity indicates that the claimed process comprises the inclusion of a liquid solution that contains the compound(s) in the specified concentration. Because the patent specifies only the molar concentration of the sulfur compound(s), and not how much of the sulfur compound(s) are added to the claimed product, there

is no way to determine how much of the sulfur compound(s) are in, and thus what structural or functional effects they may or may not have on, the claimed product. Further, the process of using a liquid solution to incorporate the claimed sulfur compounds into the claimed product in place of other methods of incorporation (e.g., a dry powder containing the sulfur compounds) would not impart any structural or functional effects to the claimed product.

26. Motif's proposal represents the true "plain and ordinary" meaning of the Molarity term. I disagree with Impossible's construction of "plain and ordinary" to the extent it contends that the Molarity Term identifies a specific quantity of sulfur compound(s) to be added to the claimed product or a specific concentration of sulfur compound(s) found in the final product once all of its ingredients are combined. Such arguments are inconsistent with the Molarity Term's plain language and how a POSITA would understand it. I further disagree with Impossible's argument that the Molarity Term, without more, imparts structural and functional differences to the claimed process and product for the reasons explained above.

IV. LEGAL UNDERSTANDING

27. In this section, I describe my understanding of certain legal principles that I have relied upon in forming my opinions set forth in this Declaration. I have been informed of these legal standards by counsel for Motif. I am not an attorney and I have not researched the law on patent invalidity. I am relying only on Motif's attorneys regarding these legal standards.

28. I have applied the standards below in my analysis of the Foodstuff Patents.

A. Person of Ordinary Skill in the Art (POSITA)

29. I understand that patent validity is determined from the perspective of a person of ordinary skill in the pertinent art at the time of the invention ("POSITA"). I understand that a POSITA is a hypothetical person who is presumed to be aware of all pertinent art, conventional wisdom in the art, and is a person of ordinary creativity—not an automaton.

30. In deciding the level of ordinary skill in the art, I am informed that the following factors may be considered: the levels of education and experience of persons working in the field; the types of problems encountered in the field; and the sophistication of the technology.

B. Claim Construction

31. I understand that claim construction is a matter of law for the Court to decide.

32. I understand that claim construction begins with the presumption that claim terms are given their ordinary and customary meaning, and that the ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art at the time of the invention (*i.e.*, the effective filing date), viewed in the context of the patent. I understand that to determine the ordinary and customary meaning of claim terms, courts may consult a variety of sources, including the claims themselves, the specification, and the prosecution history (collectively, referred to as “intrinsic evidence”), as well as relevant dictionaries and treatises, and expert testimony (collectively, referred to as “extrinsic evidence”). I also understand that intrinsic evidence is the most important source for determining the meaning of claim terms, but that extrinsic evidence may, in some circumstances, also be useful when considered in the context of the intrinsic record. I understand that extrinsic evidence cannot be used to contradict an unambiguous meaning provided in the intrinsic evidence.

33. I understand that, under some circumstances, an inventor may clearly define a claim term in the specification or the prosecution history to mean something other than its ordinary meaning. Similarly, I understand that under some circumstances, an inventor may clearly and intentionally disclaim certain claim scope within the specification or prosecution history.

34. I understand that the claim language must be considered in the context of the entire patent, including the specification and the prosecution history. Specifically, I understand that the usage of a claim term within the specification and prosecution history may provide guidance as to

the inventor's understanding of the meaning of the term and context which could assist a person of ordinary skill to ascertain the plain meaning of the claim language. At the same time, I understand that the specification usually cannot be used to import limitations into the claims, and that it is also generally improper to read limitations out of the claims.

35. I further understand that a patent may include two types of claims, independent claims and dependent claims. An independent claim stands alone and includes only the limitations it recites. A dependent claim can depend from an independent claim or another dependent claim. I am informed that a dependent claim includes all the limitations that it recites, in addition to the limitations recited in the claim from which it depends.

36. I understand that claim terms should usually be read and understood in a manner that gives meaning to all of the words in the claim and, further, gives each independent claim a distinct meaning and scope from its dependent claims. Thus, other claims (and claim elements) of the patent in question, both asserted and unasserted, can inform the meaning of a claim term. For example, because claim terms are normally used consistently throughout the patent, the usage of a term in one claim can often illuminate the meaning of the same term in other claims. Differences among claims can also be a useful guide in understanding the meaning of particular claim terms.

37. I understand that the '241 patent claims are product-by-process claims, as they claim a "meat-like-food product" that is produced by following a series of steps. I understand that the Molarity Term characterizes one of these steps and is therefore a process element of the product-by-process claim.

38. I have been informed that the scope of product-by-process claims in determining patentability is based on the product being claimed, not the process of creating the product. I further understand that the product merely produced by a new process is not patentable over a prior

art product unless its process elements impart a structural or functional difference to the product over the prior art product.

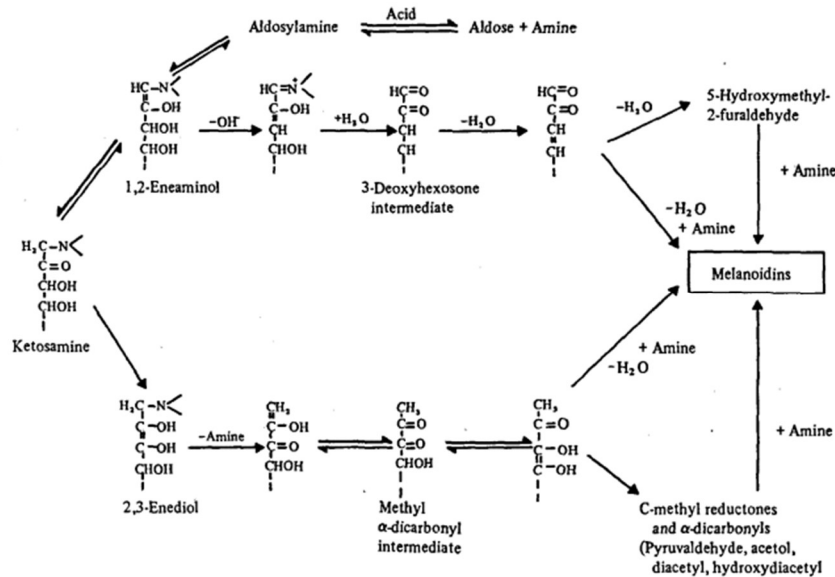
V. TECHNICAL BACKGROUND

39. Below, I review certain technical materials and principles that are relevant to my opinions in this Declaration. As I explain below, the sugar molecules and sulfur-containing molecules (*e.g.*, amino acids) claimed in the Foodstuff Patents are well-known precursors for meat flavorings in the food flavoring industry. When sugar and sulfur-containing molecules are combined in the familiar “Maillard reaction” under particular conditions, they can produce volatile compounds that, in certain circumstances, are characteristic of the aroma of cooked meats. In recognition of this result, companies in the food flavor industry have pursued patents on applications of the Maillard reaction and its precursors for approximately fifty years.

40. It is also well-known in the art that “mM” (as found in the Molarity Term) refers to an abbreviation of the SI unit millimolar. A POSITA would understand that millimolar refers to the molar concentration (*i.e.*, molarity) of an atom or molecule in a liquid solution (*i.e.*, millimoles per liter of solution). Hence, molarity is a measurement of the concentration of an atom or molecule (in number of moles) within a volume of a liquid solution. *See, e.g.*, Ex. M2, D.I. 114-1, Ex. 9 (IF_0013984).

A. Meat Flavor Precursors and the Maillard Reaction

41. In 1912, Louis Maillard reported the formation of color through the interaction of amino acids with glucose. Ex. M3 (Mottram 2007), 270. By the mid-1950s, scientists developed a scheme to explain the essential steps in this reaction. Ex. M3 (Mottram 2007), 270. This scheme still forms the basis of what scientists today refer to as the “Maillard” reaction. A depiction of its steps is reproduced below.



Ex. M4 (Dwivedi), 529 (Figure 10, Mechanism of the Maillard reactions).

42. The Maillard reaction has been recognized for over 60 years as one of the most important routes to flavor in cooked foods. Ex. M3 (Mottram 2007), 269. As I explain below, the Compound Terms refer to the precursors (reactants) that can be chemically modified via the Maillard reaction to produce flavors and aromas characteristic of natural cooked meat.

The Maillard reaction, which occurs between amino compounds and reducing sugars, is one of the most important routes to flavour compounds in cooked foods, including meat.

Ex. M5 (Mottram 1998), 417 (citations omitted).

43. As context for my discussion of the Maillard reaction, it should be understood that flavor science involves the body's physiological response to aroma and taste. The flavor experience, which is mediated by olfactory and gustatory receptors in the nose and tongue, respectively, is generally understood to be comprised of approximately 80% volatile aroma compounds and 20% non-volatile tastants. For the aroma contribution, sensory scientists refer to aromas that we sense by smell as orthonasal (smelling by inhaling through the nose) and retronasal (aroma released inside the mouth during masticating and chewing of food that is sensed by

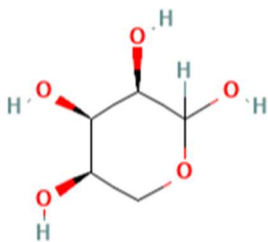
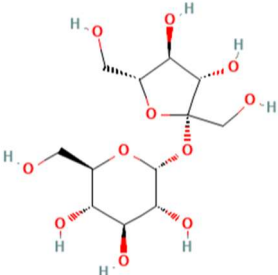
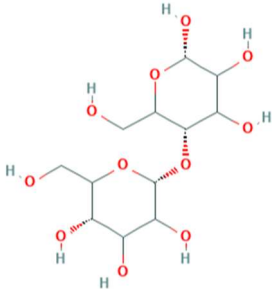
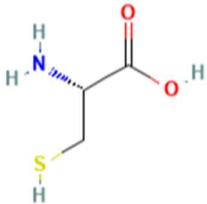
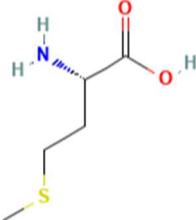
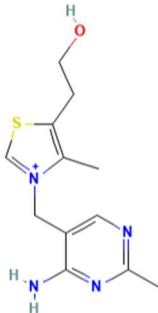
olfactory receptors via the sinus passages.) Because aroma volatiles are predominant contributors to the flavor of food, flavor and aroma are highly linked. In flavor chemistry research, the terms “aroma” and “flavor” are often used interchangeably in recognition of the dominant contribution of aroma to total flavor. The products of the Maillard reaction include volatile compounds that are perceived as aromas.

44. To create the volatile compound profiles that underlie a food’s aromas, molecules in foodstuffs can be chemically reacted using heat—that is, they are “cooked.” “The flavor of cooked meat is due to a complex mixture of compounds many of which are produced during heating.” Ex. M6 (Macleod), 310. Table 1 of Macleod and Tables 1-2 of Dwivedi list volatile compounds identified from the natural aromas of cooked meats like beef and pork. As seen in these tables, hundreds if not well over a thousand volatiles have been identified in cooked meat aromas.

45. As recognized in the art, “[t]he use of very specific precursors and thermal profiles allows for the generation of specific chemicals known to be necessary for creating the aroma of a certain species of cooked animal meat.” Ex. M7 (Reineccius), 144. Thus, the volatile compounds in aromas of cooked meat are the result of heating certain precursor molecules together.

46. The specific molecules that serve as precursors in Maillard reaction chemistry are sugars and small sulfur-containing compounds—often, sulfur-containing amino acids such as cysteine. Ex. M5 (Mottram 1998), 415 (“The main reactions during cooking, which result in aroma volatiles, are the Maillard reaction between amino acids and reducing sugars, and the thermal degradation of lipid.”). Some of these small molecules are recited as Compound Terms in some claims of the Foodstuff Patents. Below I show the structures of certain sugar molecules and sulfur-containing compounds that are recited as Compound Terms. As shown below, methionine and

cysteine are amino acids that contain a sulfur atom. Thiamine, also known as Vitamin B₁, is chemical compound that contains a sulfur atom.¹

Ribose	Sucrose	Maltodextrin
		
Cysteine	Methionine	Thiamine
		

47. The sugar and sulfur-containing compounds recited as Compound Terms are described in the food flavor literature as “flavor precursors.”

[F]lavor precursors are produced in an animal body. It is quite clear ... that meat *flavor precursors* include amino acids, small peptides, carbohydrates, particularly hexoses and pentoses, and nucleotides

Ex. M4 (Dwivedi), 502 (emphasis added).

A summary of some G.B. and U.S. patents based on “reaction products” (in which meat *flavor precursors* are allowed to react with each other) issued since 1960, is presented chronologically in Table 17.

¹ These structures are obtained from the publicly available PubChem database entry for each compound.

Ex. M6 (MacLeod), 399 (emphasis added). Table 17 is partially excerpted below.

48. It perhaps goes without saying that the “flavor precursors” of natural meat flavor are present in meat itself. As exemplified below, meat contains various kinds of sugars, such as carbohydrates and derivatives of nucleotides (the building blocks of DNA). Meat also contains sulfur-containing amino acids such as cysteine and methionine.

Sugars and sugar phosphates identified from meat extracts include: fructose, fructose-6'-phosphate, fructose-1,6'-diphosphate, glucose, glucose-6'-phosphate, ribose, and ribose-5' phosphate.

Ex. M4 (Dwivedi), 503.

Inosinic acid (inosine-5'-monophosphate, 5'-IMP), has already been mentioned as a beef flavor precursor. It is produced from ATP post-mortem. Resting muscle contains 5-7 micromoles per gram of ATP; this is the major nucleotide in live muscle. ... Thus nucleotides are potential sources of reducing sugars, in particular free ribose and ribose phosphate—well-known Maillard reaction participants.

Ex. M6 (MacLeod), 365-66 (footnotes omitted)).

TABLE 3

Potential Flavor Precursors Isolated from Meat Extracts

Alanine	Fructose-6'-phosphate	Lysine
β -Alanine	Glucose	Methionine
quaternary Amines	Glucose-6'-phosphate	Methylhistidine
Ammonia	Glutamic acid	Nicotinamide-adeninedinucleotide
Anserine	Glutamine	Ornithine
Arginine	Glutathione	Peptides
Asparagine	Glycerophosphoethanolamine	Phenylalanine
Aspartic acid	Glycine	Phosphoethanolamine
Carnitine	Glycoproteins	Phosphoserine
Carnosine	Histidine	Proline
Citrulline	Hydroxyproline	Purine-nucleosides
Creatine	Hypoxanthine	Purine-nucleotides
Creatinine	Inosine-5'-monophosphate	Ribose
Cysteine	and other nucleotides	Ribose-5'-phosphate
Cystine	Isoleucine	Serine
Fructose	Leucine	Taurine
		Threonine
		Tyrosine
		Urea
		Valine

Ex. M4 (Dwivedi), Table 3.

49. Amino acids often serve as the building blocks of protein. A POSITA would understand that proteins themselves are not considered Maillard reactants, however. Indeed, these Maillard reactants are able to react chemically because, in part, they are separate and independent from larger protein structures. As explained in the literature, for a protein to be used as a flavor precursor, it needs to be processed into its components (amino acids). In the art, these processed proteins are referred to as “hydrolysates.”

[H]ydrolyzed vegetable proteins (hydrolysates/HVP) were the first process flavors. These materials are products of acid hydrolysis of proteins (usually of plant origin, but can be from animal protein). They acquire their flavor from the acid hydrolysis of the protein to amino acids and from the heating steps.

Ex. M7 (Reineccius), 141-42.

Industrially, three hydrolysis methods are possible Complete hydrolysis of the protein is desirable, and the higher the ratio of acid to protein the lower the extent of amino acid destruction and the better the flavor; equally large excesses of acid are avoided because of the high salt levels which would result on neutralization.

Ex. M6 (Macleod), 398.

The production of high quality hydrolyzed proteins and yeast autolysates made further contributions to the development of meat flavorings. This was not surprising, since free amino acids are known meat flavor precursors.

Ex. M6 (Macleod), 398 (citation omitted).

50. Indeed, the art teaches, and a POSITA would recognize, that Maillard reaction precursors are small-molecule compounds. As Macleod *et al.* note, “[o]nly low molecular weight water-soluble materials are meat flavor precursors.” Ex. M6 (Macleod), 364. Dwivedi *et al.* report that “[i]t is quite clear from the patent literature cited earlier and other reported findings that meat flavor precursors include amino acids, small peptides, carbohydrates, particularly hexoses and pentoses, and nucleotides (Table 3).” Ex. M4 (Dwivedi), 502. Similarly, Mottram states that “[c]ooked foods develop characteristic flavour and colour and the main reactions which take place

are the breakdown of lipid, sugars, amino acids, carotenes, thiamine and other trace food components.” Ex. M3 (Mottram 2007), 269.

B. Industry Use of Flavor Precursors

51. The practical significance of the relationship between the Maillard reaction and meaty flavor and aroma is manifested in the number of patents owned by commercial entities covering aspects of this relationship. As exemplified in the references cited below, the long use of sugar and sulfur compounds in the food flavor industry further supports my view that a POSITA would understand the claimed Compound Terms to recite meat flavor precursors (*i.e.*, Maillard reactants), which are separate, standalone ingredients that are not the same as other food product ingredients (such as proteins).

Studies of the aromas produced on heating mixtures of amino acids and sugars, confirmed the important role played by cysteine and ribose in meat flavour formation and led to the classic patent of Morton *et al.* (1960) which involved the formation of a meat-like flavour by heating a mixture of these compounds. Most subsequent patent proposals for ‘reaction product’ meat flavourings have involved sulfur, usually as cysteine or other sulfur-containing amino acids.

Ex. M5 (Mottram 1998), 416 (citations omitted).

52. I reproduce below parts of Table 17 from the Macleod reference. This table summarizes the use of certain Maillard reactants to produce meat aroma “reaction products” which could be used in food products. Table 17 provides examples of the well-known use of sugar and sulfur-containing compounds in the food flavor industry as precursors that can produce meat aromas (under specific reaction conditions). These compounds include the specifically claimed Compound Terms—*e.g.*, ribose, glucose, xylose, cysteine, cystine, and thiamine. *See also* Ex. M6 (Macleod), 400-07.

Table 17
SOME G.B. AND U.S. "REACTION PRODUCTS" PATENTS

Table entry	Patent no., (year)	Assigned to or inventor(s)	Flavor	Reaction
1	G.B. 836,694 (1960)	Morton et al. ²⁵⁰	Meat	In general cysteine + additional amino acids (other than phenylalanine and methionine) or in a hydrolyzed protein form + a pentose or hexose
			Cooked pork	Cysteine + ribose
			Roasted beef	Cysteine + glutamic acid + β -alanine + glycine + ribose + glucose
			Roasted beef	A sulfur-containing polypeptide (e.g., glutathione) + ribose
			Cooked meat	Cysteine + casein hydrolysate or groundnut hydrolysate + glucose + xylose
			Roasted beef	Cysteine + defatted cod fish flesh or soybean protein hydrolysate + ribose
2	U.S. 2,934,435 (1960)	May and Neots ²⁵¹	Meat-like	An amino acid source (cysteine or cystine essential) + a pentose + a furan or 2-substituted furan, e.g., furfural
3	U.S. 2,934,436 (1960)	May et al. ²⁵²	Meat-like	Cysteine or cystine + glyceraldehyde
4	U.S. 2,934,437 (1960)	Morton et al. ²⁵³	Meat-like	Cysteine or cystine + a pentose or hexose or glyceraldehyde
5	U.S. 2,955,041 (1960)	Broderick et al. ²⁵⁴	Meat-like	2-Mercaptoethanol derivatives, e.g., mercaptoacetaldehyde, 2,5-dihydroxy-1,4-dithiane + a food (medium)
6	G.B. 858,333 (1961)	May ²⁵⁵	Meat-like	Cysteine + a mixture of certain amino acids + furan or a 2-substituted furan
7	G.B. 858,660 (1961)	May and Morton ²⁵⁶	Meat-like	Cysteine + additional amino acids other than methionine and phenylalanine + defatted fish protein (optional) + aldehydes (acyclic and at least C ₃)
8	U.S. 3,157,516 (1964)	Huber et al. ²⁵⁷	Chicken	Cysteine or cystine + ascorbic acid or isoascorbic acid
9	G.B. 1,032,334 (1965)	Nestlé Products, Ltd. ²⁵⁸	Meat extract like	Cysteine or glutathione or protein in a hydrolysate form, e.g., yeast, blood, liver + a mixture of amino acids + a pentose or hexose + 5'-nucleotide (optional) + lactic acid
10	G.B. 1,082,504 (1965)	Pfizer Co. ²⁵⁹	Beef	Cysteine + alanine + glycine + glutamic acid or its acceptable salt + HVP + a pentose or hexose + sucrose + 5'-nucleotides + edible fat
11	G.B. 1,099,711 (1965)	International Flavors and Fragrances, Inc. (I.F.F.) ²⁶⁰	Beef	Cysteine + yeast hydrolysate + 5'-nucleotides (optional) + MSG (optional) + inorganic

Pork	salts such as chlorides and phosphates (optional) Methionine + yeast hydrolysate + 5'-nucleotides (optional) + inorganic salts such as chlorides and phosphates (optional)
Roasted meat	Cysteine + yeast hydrolysate + pyruvic acid, pyruvaldehyde or dihydroxyacetone + MSG, 5'-nucleotides (optional) + inorganic salt such as phosphates and chlorides (optional)

VI. PERSON OF ORDINARY SKILL IN THE ART

53. The Foodstuff Patents are directed to the art of food science. In my opinion, a POSITA for the Foodstuff Patents would have a Master's degree or Ph.D. in food science or at least three years of experience working as a food scientist. A POSITA could also be part of a team of food scientists, including flavor chemists. In this Declaration, I provide my opinions based on the knowledge and understanding of a POSITA for the Foodstuff Patents.

54. In parallel *inter partes* review proceedings, I have offered opinions regarding the priority date for the '096 and '241 Patents. In this Declaration, I am not offering any opinions regarding a priority date for any of the Foodstuff Patents. I reserve all rights to do so in the future. For the purposes of this Declaration only, I provide my opinions with respect to the knowledge of a POSITA working in the field as of July 12, 2011.

55. I meet or exceed the qualifications of a POSITA.

VII. FOODSTUFF PATENTS

A. Claims

56. I have reviewed the Foodstuff Patents. Claim 1 from each patent is reproduced below. As shown below, certain claims recite "the production of at least two volatile compounds" that are "associated with" either a "meat-associated" ('096 and '241 patents) or "beef-like" aroma ('306 and '250 patents). Claim 1 of the '761 patent does not recite "cooking" the claimed "beef replica" or the production of aromas. However, the inclusion of the claimed sugar and sulfur

compounds in that claim is consistent with the recitation of the Compound Terms in the claims of the other four Foodstuff Patents. I emphasize the Compound Terms (and Molarity Term) below.

57. Claim 1 of the **'096 patent** recites:

A food flavor additive composition comprising:

a) an isolated heme-containing protein;

b) a compound selected from glucose, ribose, fructose, lactose, xylose, arabinose, glucose-6-phosphate, maltose, maltodextrin, and galactose, and mixtures of two or more thereof; and

c) a compound selected from cysteine, cystine, thiamine, methionine, and mixtures of two or more thereof;

wherein the flavor additive composition contains no animal products; and

wherein cooking the food flavor additive composition results in the production of at least two volatile compounds which have a meat-associated aroma.

Ex. M8, '096 patent claim 1.

58. Claim 1 of the **'306 patent** recites:

A method for imparting a beef-like aroma to a meat replica matrix,

wherein the meat replica matrix comprises one or more plant proteins,

a sugar selected from glucose, ribose, sucrose, fructose, xylose, maltodextrin, and combinations thereof,

and at least one sulfur compound selected from methionine, cysteine and thiamine,

the method comprising adding 0.01%-5% (by weight of the meat replica matrix) of a non-animal heme-containing protein to the meat replica matrix,

wherein, upon cooking of the meat replica matrix, at least two volatile compounds are generated that are associated with a beef-like aroma, thereby imparting a beef-like aroma to the meat replica matrix.

Ex. M9, '306 patent claim 1.

59. Claim 1 of the **'250 patent** recites:

A meat replica matrix comprising:

one or more plant proteins;

a sugar selected from glucose, ribose, sucrose, fructose, xylose, maltodextrin, and combinations thereof;

at least one sulfur compound selected from methionine, cysteine, and thiamine;

and 0.01%-5% (by weight of the meat replica matrix) of a non-animal heme-containing protein,

wherein, upon cooking of the meat replica matrix, at least two volatile compounds are generated that are associated with a beef-like aroma.

Ex. M10, '250 patent claim 1.

60. Claim 1 of the **'241 patent** recites:

A meat-like-food product produced by a method comprising:

providing one or more plant proteins; and

combining, with the one or more plant proteins:

a composition comprising a heme-containing protein, wherein the composition comprises at least 60% of the heme-containing protein on a dry weight basis;

a compound selected from glucose, ribose, fructose, lactose, xylose, arabinose, glucose-6-phosphate, maltose, and galactose, and mixtures of two or more thereof;

and a compound selected from cysteine, cystine, thiamine, methionine, and mixtures of two or more thereof in a concentration of at least 1.5 mM;

wherein the meat-like food product is free of animal heme-containing protein; wherein cooking the meat-like-food-product results in the production of at least two volatile compounds which have a meat-associated aroma; and

wherein the meat-like food product is in a form selected from the group consisting of a hotdog, a burger, ground meat, a sausage, a steak, a filet, a roast, a meatball, a meatloaf, or bacon.

Ex. M11, '241 patent claim 1.

61. Claim 1 of the **'761 patent** recites:

A beef replica product, comprising:

a) a muscle replica comprising 0.1%-5% of a heme-containing protein, *at least one sugar compound and at least one sulfur compound*; and

b) a fat tissue replica comprising at least one plant oil and a denatured plant protein,

wherein said muscle replica and fat tissue replica are assembled in a manner that approximates the physical organization of meat.

Ex. M12, '761 patent claim 1.

62. The dependent claims recite different aspects or features of the claimed products.

From my review of the dependent claims, none recite the Compound Terms in a manner inconsistent with my opinions in this Declaration.

B. Specification

63. I have reviewed the specifications of the Foodstuff Patents. Although the specifications are not identical, in my opinion they describe the claimed Compound Terms consistently such that a POSITA would understand that the patents' inventors are describing the well-known small-molecule Maillard reactants I discuss above.

64. As exemplified below, the patents teach that sugar and sulfur-containing compounds are added to replica products as ingredients to achieve meat aromas in replica products.² Although these compounds are naturally present in real meat as I explain above, a POSITA would understand that a *replica* product would not necessarily contain these compounds

² In making this observation, I do not assert that the Foodstuff Patents adequately teach or describe methods of achieving the claimed aromas or that the specifications would enable to make and use to POSITA to practice the full scope of the claimed methods without undue experimentation. In fact, producing particular aromas involves various factors such as identity of the precursor(s), reaction temperature, time, and pH, as well as the presence of other components in the chemical reaction. I reserve all rights to offer opinions on this subject at a later date if called to do so.

and, consequently, that the compounds would need to be added to the product in order to achieve the desired aroma.

65. Consistent with the patents' discussion of achieving meat replicas, certain patents explicitly refer to sugar and sulfur-containing compounds as "flavor precursors" and even "Maillard reaction precursors." For example, the '096 patent states that its "invention relates to food products and more particularly, to food products that include ... one or more flavor precursor molecules." Ex. M8, '096 patent 1:22-25. In some parts of the disclosure, the patents discuss a "Flavor Precursor Mix" or a "Magic Mix" that contains sugar and sulfur-containing compounds, which a POSITA would recognize as Maillard reaction precursors. Notably, as shown below in '096 patent Table 13 and '306 patent Table 5, the ingredients of these two mixes are the same. I excerpt certain exemplary support below.

The food product can include two to one hundred, two to fifty flavor precursors, two to forty flavor precursors, two to thirty-five flavor precursors, two to ten flavor precursors, or two to six flavor precursors. In some embodiments, the one or more flavor precursor molecules are selected from the group consisting of glucose, ribose, cysteine, a cysteine derivative, thiamine, alanine, methionine, lysine, a lysine derivative, glutamic acid, a glutamic acid derivative, IMP, GMP, lactic acid, maltodextrin, creatine, alanine, arginine, asparagine, aspartate, glutamic acid, glutamine, glycine, histidine, isoleucine, leucine, methionine, phenylalanine, proline, threonine, tryptophan, tyrosine, valine, linoleic acid, and mixtures thereof.

Ex. M8, '096 patent 4:36-49.

Example 11—Creation of Beefy Flavors Using Complex Precursor Mixtures

A formulation was prepared (the "magic mix," see Table 13 containing the estimated concentrations of amino acids, sugars, and other small molecules in beef based on their values reported in literature.

Ex. M8, '096 patent 32:49-55.

TABLE 13

Chemical entities added to the Magic Mix	
Chemical entity	mM
Alanine	5.6
Arginine	0.6
Asparagine	0.8
Aspartate	0.8
Cysteine	0.8
Glutamic acid	3.4
Glutamine	0.7
Glycine	1.3
Histidine	0.6
Isoleucine	0.8
Leucine	0.8
Lysine	0.7
Methionine	0.7
Phenylalanine	0.6
Proline	0.9
Threonine	0.8
Tryptophan	0.5
Tyrosine	0.6
Valine	0.9
glucose	5.6
Ribose	6.7
Maltodextrin	5.0
Thiamine	0.5
GMP	0.24
IMP	0.6
Lactic acid	1.0
creatine	1.0
NaCl	10
KCl	10
Kphos pH 6.0	10

Ex. M8, '096 patent Table 13.

Example 27. Preparation of the Flavor Precursor Mix

A flavor precursor mix was prepared by mixing concentrated stock solutions of each additive to make a 17× solution. Table 5 contains the chemical composition of the mix and the mM concentration of each component in the final burger.

Ex. M9, '306 patent 80:10-18.

TABLE 5

Chemical composition of the flavor precursor mix.	
Chemical entity	mM
Alanine	5.6
Arginine	0.6
Asparagine	0.8
Aspartate	0.8
Cysteine	0.8
Glutamic acid	3.4
Glutamine	0.7
Glycine	1.3
Histidine	0.6
Isoleucine	0.8
Leucine	0.8
Lysine	0.7
Methionine	0.7
Phenylalanine	0.6
Proline	0.9
Threonine	0.8
Tryptophan	0.5
Tyrosine	0.6
Valine	0.9
glucose	5.6
Ribose	6.7
Maltodextrin	5.0
Thiamine	0.5
GMP	0.2
IMP	0.6
Lactic acid	1.0
creatine	1.0
NaCl	10
KCl	10
Kphos pH 6.0	10

Ex. M9, '306 patent Table 5.

66. Example 33 of the '306 patent provides an example of how the sugar and sulfur-containing compounds are used. As shown in Table 8 below, this Example discusses an experiment in which different mixes of sugar and sulfur-containing compounds are added to test replica products (plant-based burgers, sample numbers 767 and 929) but not added to control replica burgers (sample number 804). The Example explicitly describes the compounds as “flavor precursors.” After the replica products are heated, they produce volatile “beef flavor compounds” reported in Table 10.

Example 33: Generation of Beef Flavor in Replica Burgers by the Addition of Heme and Flavor Precursors

Characteristic flavor and fragrance components in meat are mostly produced during the cooking process by chemical reactions molecules (precursors) including amino acids, fats and sugars that are found in plants as well as meat. Flavor precursors

along with 1% Leghemoglobin were added to the muscle component of the burger replicas as indicated in Table 8. Three replicas, one with no precursors, and two different mixtures of precursors, along with 80:20 beef were cooked then served to a trained sensory panel to describe the flavor attributes shown in Table 9. The addition of precursors increased the beefy flavor, the bloody notes, overall flavor quantity, and decreased the off notes in the replica.

Ex. M9, '306 patent 84:5-20.

TABLE 8

Flavor precursors added to the beef replicas before cooking.			
Additive (mm)	Samples		
	767 Precursor Mix 1	804 No Precursors	929 Precursor Mix 2
Alanine	5.61		5.61
Cysteine	0.83		0.83
Glutamic acid	3.40		3.40
Leucine	0.76		0.76
Lysine	0.68		0.68
Methionine	0.67		0.67
Tryptophan	0.49		0.49
Tyrosine	0.55		0.55
Valine	0.85		0.85
Glucose	5.55		5.55
Ribose	6.66		6.66
Lactic acid	1.00		1.00
creatine	1.00		1.00
Thiamine	0.50		0.50
IMP + GMP	0.40		0.40
Sucrose			2.00
Fructose			2.00
Xylose			2.00
Maltodextrin	0.50%		0.50%

Ex. M9, '306 patent Table 8.

67. Table 9 reports sensory scores from cooking the test and control burgers. Table 9 shows, *e.g.*, that “Flavor: Beefy” increased in the burgers to which sugar and sulfur-containing compounds are added (nos. 767 and 929), compared to the control burger (no. 804).

TABLE 9

The sensory score determined by the sensory panel for the replica burgers and 80:20 beef sample.					
		Sample #			
		Beef	767	804	929
Flavor Quality	mean	7.0	3.8	3.2	4.3
	STDEV	0.0	1.3	1.0	1.2

Flavor Intensity	mean	4.3	4.2	4.3	4.3
	STDEV	0.8	1.2	1.4	1.2
Flavor: Beefy	mean	5.8	3.3	2.3	4.2
	STDEV	1.0	1.2	0.8	1.2
Flavor: bloody/Metallic	mean	4.5	2.0	2.2	3.2
	STDEV	1.2	1.0	0.9	1.4
Flavor: Savory	mean	3.3	3.8	3.7	4.2
	STDEV	1.2	1.2	1.2	1.8
Off Flavors:	mean	1.5	2.3	3.5	2.7
chemical/oxidized/beany	STDEV	0.8	1.2	1.8	1.0

Ex. M9, '306 patent Table 9.

68. The specifications makes clear that plant proteins are neither flavor precursors themselves nor the source of flavor precursors in replica products. For example, proteins are not listed as “Flavor Precursor Molecules” in Table 1 of the '096 patent. Rather, Table 1 lists individual amino acids and protein hydrolysates. As I explain above, the term “hydrolysates” refers to proteins that have been broken down (hydrolyzed) into much smaller pieces (peptides) or individual amino acids rather than proteins themselves, which are typically large and complex molecules often hundreds or thousands of amino acids in size.

TABLE 1

Flavor Precursor Molecules
Sugars, sugar alcohols, sugar acids, and sugar derivatives: glucose, fructose, ribose, sucrose, arabinose, glucose-6-phosphate, fructose-6-phosphate, fructose 1,6-diphosphate, inositol, maltose, molasses, maltodextrin, glycogen, galactose, lactose, ribitol, gluconic acid and glucuronic acid, amylose, amylopectin, or xylose Oils: coconut oil, mango oil, sunflower oil, cottonseed oil, safflower oil, rice bran oil, cocoa butter, palm fruit oil, palm oil, soybean oil, canola oil, corn oil, sesame oil, walnut oil, flaxseed, jojoba oil, castor, grapeseed oil, peanut oil, olive oil, algal oil, oil from bacteria or fungi Free fatty acids: caprylic acid, capric acid, lauric acid, myristic acid, palmitic acid, palmitoleic acid, stearic, oleic acid, linoleic acid, alpha linolenic acid, gamma linolenic acid, arachidic acid, arachidonic acid, behenic acid, or erucic acid Amino acids and derivatives thereof: cysteine, cystine, a cysteine sulfoxide, allicin, selenocysteine, methionine, isoleucine, leucine, lysine, phenylalanine, threonine, tryptophan, 5-hydroxytryptophan, valine, arginine, histidine, alanine, asparagine, aspartate, glutamate, glutamine, glycine, proline, serine, or tyrosine Nucleosides and Nucleotides: inosine, inosine monophosphate (IMP), guanosine, guanoside monophosphate (GMP), adenosine, adenosine monophosphate (AMP) Vitamins: thiamine, vitamin C, Vitamin D, Vitamin B6, or Vitamin E Misc: phospholipid, lecithin, pyrazine, creatine, pyrophosphate Acids: acetic acid, alpha hydroxy acids such as lactic acid or glycolic acid, tricarboxylic acids such as citric acid, dicarboxylic acids such as succinic acid or tartaric acid Peptides and protein hydrolysates: glutathione, vegetable protein hydrolysates, soy protein hydrolysates, yeast protein hydrolysates, algal protein hydrolysates, meat protein hydrolysates Extracts: a malt extract, a yeast extract, and a peptone

Ex. M8, '096 patent Table 1.

69. In contrast, the patents do not teach that plant proteins are Maillard reaction precursors. In fact, the patents teach that plant proteins can contribute to undesirable flavors and aromas. Specifically, the patents teach that plant proteins are associated with “planty” aromas and “off-flavors.” Ex. M9, '306 patent 13:52-56; 87:19-46; 87:63-88:9, Examples 16, 34. The patents also describe that the milieu of the replica foodstuffs, such as plant protein-containing “tissue

replicas,” can affect flavors. From the disclosure, a POSITA would understand that plant proteins are not used as flavor precursors in replica foodstuffs. A POSITA would understand that plant proteins are used in replica products for other purposes.

70. Accordingly, the patents teach that the molecules recited as Compound Terms are added to the replica product in order to produce meat aromas that would contribute to the “replica” qualities of the foodstuff.

C. Relevant Prosecution History

71. I have reviewed the prosecution records of the Foodstuff Patents. Although I do not provide an exhaustive summary of their prosecution in this Declaration, my understanding is that the applicant (*i.e.*, Impossible Foods and its prosecution counsel) used the Compound Terms during prosecution to refer to flavor precursor additives.

72. It is my understanding that, during prosecution of the ’306 patent, the applicant attempted to obtain claims reciting, e.g., beef-like flavor. For example, in pending claims dated January 12, 2017, and after several rejections of the claims by the Patent Office Examiner, the applicant amended the claims as shown in exemplary pending claim 1 reproduced below. Ex. M13. These claims do not recite the Compound Terms molecules, but they recite other components of a “meat replica matrix” including “one or more plant proteins” and “an isolated heme-containing protein.” The Examiner did not allow these claims.

1. (Currently Amended) A method for imparting a beef-like flavor to a consumable product, wherein the consumable product ~~is~~ comprises a meat replica matrix that contains no animal products and comprises one or more plant proteins, comprising ~~obtaining an isolated heme-containing protein; and~~ adding, to incorporating into the meat replica matrix of the consumable product[[,]] 0.01%-5% (by weight of the consumable) of ~~the~~ an isolated heme-containing protein, wherein, after cooking, a beef-like flavor is imparted to the consumable product.

73. Subsequently, on October 17, 2017, the applicant amended the independent claims of the '306 patent application to recite the Compound Terms and, relatedly, the generation of “at least two volatile compounds” “associated with a beef-like aroma”, as reproduced below. Ex. M14.

1. (Currently Amended) A method for imparting a beef-like aroma flavor to a meat replica matrix consumable product, wherein the ~~consumable product~~ comprises a meat replica matrix ~~[[that]]~~ contains no animal products and comprises one or more plant proteins, a sugar selected from glucose, ribose, sucrose, fructose, xylose, maltodextrin, and combinations thereof and at least one sulfur compound selected from methionine, cysteine and thiamine, the method comprising

~~adding~~ incorporating into the meat replica matrix of the consumable product 0.01%-5% (by weight of the meat replica matrix consumable) of ~~an isolated~~ a heme-containing protein to the meat replica matrix,

wherein, ~~after upon~~ cooking of the meat replica matrix, at least two volatile compounds are generated that are associated with a beef-like aroma, thereby imparting a beef-like aroma flavor is imparted to the meat replica matrix consumable product.

74. The applicant's amendment to add the Compound Terms molecules, which are claimed separately and distinctly from other claimed components of the replica, is consistent with how a POSITA would understand the Compound Terms as I explain in this Declaration.

75. I have reviewed declarations offered by Impossible Foods during prosecution of the Foodstuff Patents. These declarations further demonstrate that the Compound Terms refer to flavor precursor molecules. In particular, three declarations by Dr. Celeste Holz-Schietinger dated July 10, 2015 disclose tests in which reaction mixtures containing combinations of these free flavor precursors (e.g., the sugars ribose and glucose and the sulfur compounds cysteine and thiamine) were heated in combination with soybean leghemoglobin, and monitored for volatile compounds. Exs. M15-M17.

76. The Examiner's statements in the April 4, 2018 Notice of Allowance (page 7) allowing the '306 patent claims are also consistent with my interpretation of the Compound Terms.

Ex. M18. These statements are reproduced below. As shown below, the Examiner recognized that the sugar compound ribose and the sulfur compound cysteine are Maillard reaction “precursors” that “are important for meat aroma and are consequently employed in the product [sic] of meat flavors.” The Examiner discussed the claimed protein components of the meat replica matrix on a different page of the Notice of Allowance (page 6). The Examiner’s findings further support my view that the Examiner understood the claimed Compound Term molecules as flavor (aroma) precursor ingredients added to the foodstuff for the purpose of achieving the claimed aromas, and are different from the claimed proteins or other components of the foodstuff.

Cerny et al. (“Formation of Aroma Compounds from Ribose and Cysteine during the Maillard Reaction” -*J. Agric. Food Chem.*, 2003, 51, pp. 2714-2721) teach that the Maillard reaction plays a substantial role in flavor generation during the cooking of meat (p. 2714/Introduction). Cerny et al. teach that besides, thiamine, the precursors ribose and cysteine are important for meat aroma and are consequently employed in the product of meat flavors (Abstract, p. 2714/Introduction).

While Cerny et al. disclose that mixtures of ribose and cysteine, when heated, are known to produce flavors associated with meat, Applicants have demonstrated that the combination of: (a) a heme-containing protein b) compound selected from glucose, ribose, fructose, sucrose, xylose, maltodextrin and combinations thereof; and (c) at least one sulfur compound selected from methionine, cysteine and thiamine produces novel (i.e. not produced in the absence of heme-containing protein) volatile compounds associated with a meaty aroma upon heating.

VIII. THE COMPOUND TERMS REFER TO ADDED FLAVOR PRECURSORS

77. In my opinion, a POSITA would understand that the Compound Terms refer to small-molecule flavor precursors that are added to a replica product. More specifically, where the Compound Terms recite specific compounds (ribose, glucose, cysteine, methionine, and the like), a POSITA would understand that the terms refer to those free, standalone molecules, rather than their inclusion as part of a larger and more complex structure such as a protein. Indeed, a POSITA

would understand that the Compound Terms refer to different ingredients of a replica foodstuff than proteins such as plant proteins. Moreover, a POSITA would understand from the patents that the Compound Term ingredients are added to the replica before it is cooked and does not refer to degradants caused by cooking proteins in the food.

78. As I explain in detail above, natural meat contains small molecules, including sugar molecules and amino acids. When natural meat is heated to sufficiently high temperatures, these small molecules react to produce volatile compounds with aromas characteristic of the meat being cooked. In recognition of this phenomenon, the food flavor industry has long used sugar and sulfur-containing molecules as meat flavor precursors (Maillard reactants) to produce profiles of volatile compounds that mimic the flavor and aroma of meat. When heated under certain conditions, these precursors can generate volatile compounds that are characteristic of natural meat aroma via the well-known “Maillard reaction.” As I explain above, a POSITA would be very familiar with the role of sugar and sulfur-containing molecules as flavor precursors in meat and as precursors for artificial meat aroma reaction products.

79. Accordingly, I agree with Motif’s proposed constructions for the Compound Terms. Motif’s proposal correctly reflects how a POSITA would understand the Compound Terms as they are used in the context of claims. From the context of the Foodstuff Patent claims, the Compound Terms are ingredients in the claimed replica products. The ’306 and ’250 patent claims recite the combination of the sugar and sulfur-containing compounds with other ingredients (*e.g.*, plant proteins) in a meat replica matrix and—after cooking—certain volatile compounds are produced. The Compound Terms’ usage in the ’096 and ’241 patent claims is essentially the same. Although the ’761 patent does not expressly recite the production of an aroma, a POSITA would recognize the significance of the recited Compound Terms in light of these compounds’ long utility

in the food flavor art. Thus, for all Foodstuff Patents, a POSITA would understand that these ingredients (the Compound Terms) are flavor precursors added to the replica for the purpose of achieving flavor, and specifically meat aroma mimicry in a meat replica.

80. Furthermore, Motif's proposal correctly reflects how a POSITA would understand the Compound Terms in light of the Foodstuff Patents' specifications and prosecution history. As I explain above, for example, the patents explicitly describe sugar and sulfur-containing compounds as flavor precursors and as components of a Maillard reaction mix. The patents also provide examples of the use of these compounds to produce various aromas.

81. Motif's proposal therefore represents the true ordinary meaning of the Compound Terms. I disagree with Impossible's construction. In particular, a POSITA would not understand the Compound Terms to cover arguable "compounds" such as plant proteins. The claims recite plant proteins separately from the Compound Terms. As excerpted below, for example, claim 1 of the '306 patent recites four separate ingredients—two proteins, and two sets of Compounds—distinguishing the Compounds from the proteins.

...the meat replica matrix comprises [1] *one or more plant proteins*, [2] *a sugar* selected from glucose, ribose, sucrose, fructose, xylose, maltodextrin, and combinations thereof, and [3] *at least one sulfur compound selected from* methionine, cysteine and thiamine, the method comprising adding 0.01%-5% (by weight of the meat replica matrix) of [4] *a non-animal heme-containing protein*
...

82. Moreover, a POSITA would understand that, although plant proteins may contain amino acids as part of the protein structure, those proteins do not contribute to characteristically meat-like flavor (which includes aroma) unless they are hydrolyzed to release the amino acids. Indeed, the Foodstuff Patents acknowledge that plant proteins can contribute to flavor in undesirable ways as I explain above.

IX. THE MOLARITY TERM REFERS TO THE CONCENTRATION OF A STARTING INGREDIENT, NOT THE CLAIMED PRODUCT

A. Claim Language

83. Claim 1 recites a meat-like-food product produced by a method the comprises providing “one or more plant proteins” and then “combining” those plant proteins with three other ingredients: “a composition comprising a heme-containing protein...,” “a compound selected from glucose...,” and “a compound selected from cysteine ... in a concentration of ... 1.5 mM.” Ex. M11. In my opinion, because the claim language recites four distinct ingredients that are combined together as part of a method to make a product, a POSITA would understand that the “1.5 mM” concentration refers to the concentration of the sulfur-containing compound as a starting ingredient that is added to the final meat-like-food product. A POSITA would thus understand that the claimed process involves combining a liquid solution containing the claimed sulfur compounds “in a concentration of at least 1.5 mM” with other ingredients recited in claim 1 of the ’241 patent including “one or more plant proteins,” “a composition comprising a heme-containing protein...,” and “a compound selected from glucose....”

84. Notably, however, nothing in the claim language specifies what quantity of sulfur compounds or volume of 1.5 mM solution should be added as part of the claimed process. Indeed, the claim is silent regarding the amount of each ingredient involved in the claimed process, both in absolute or relative terms. In the absence of this information, a POSITA has no basis to determine whether, or to what extent, the molar concentration of the sulfur compounds generates structural or functional effects in the claimed product.

85. Even when the molarity of a sulfur compound is known, its effects in a meat-like-food product entirely depend on how much of the compound has been added relative to other ingredients. For example, an extremely high molarity sulfur compound could be undetectable in

in the claimed meat-like-food product if a very small amount is combined with large amounts of the other claimed components (and any number of additional components, since claim 1 is a “comprising” claim). Conversely, a sulfur compound with a low molarity may nonetheless make up the majority of a meat-like-food product if far more of it is added than other required components.

86. Additionally, even holding all else equal, not knowing how much of a sulfur compound in a concentration of at least 1.5 mM must be added renders it impossible to determine whether an increase or decrease in molarity alone will lead to different results. Indeed, sulfur compounds of differing molarities may, ultimately, have the same effect due to how much is added. For example, 5 mL of a compound containing cysteine at a concentration of 3 mM would ultimately provide the same amount of cysteine to the claimed product as 10 mL at a concentration of 1.5 mM and, thus, the claimed product would be structurally and functionally the same.

87. The use of a *solution* containing the claimed sulfur compounds in a concentration of at least 1.5 mM also lacks any structural or functional effects on the claimed meat-like-food product. Because only the *amount* of sulfur compounds in a meat-like-food product relative to other compounds in the product ultimately affects the product’s aroma and flavor profile, it does not matter whether those compounds are added via liquid solution or dry powder.

B. Specification and Prosecution History the ’241 Patent

88. As noted above, I have reviewed the specification of the ’241 patent. In my opinion, the specification’s teachings are consistent with the opinions I offer herein.

89. In describing the use of sulfur compounds in meat-like-food products, the only specific measurement the ’241 patent specification provides is the concentration of the sulfur compounds, specifically, their molar concentration in terms of millimolar. ’241 patent, 20:7-9 (“Replica burgers containing ... the flavor precursors cysteine (10 mM) ... and thiamine (1 mM)

....”); Table 7 (listing various sulfur compounds in terms of “mM”); 28:33-37 (“Oils ... were added to ... a Maillard reaction mix (MRM) containing 50 mM potassium phosphate [buffer] pH 6.0, 5 mM Cysteine, 10 mM Glucose, 0.1 mM Thiamine”). As discussed above, a POSITA would understand that the use of millimolar indicates that liquid solutions containing the sulfur compounds are in use. This is particularly true in light of the fact that the specification uses molarity terms in other instances in which it explicitly refers to the concentration of solutions. ’241 patent, 28:33-40 (discussing the use of a “50 mM potassium phosphate buffer”); 40:56-59 (discussing the use of “2 mL of 10 M HCl” in a solution). Such examples also demonstrate that Impossible was aware that the volume or amount of a solution is a different measurement than its molarity. *See* ’241 patent, 40:56-58 (“To the residual green suspension (500 mL) was added 2 mL of 10 M HCL, causing the suspension to turn brown.”).

90. I understand that Impossible asserts that because the examples provided in the ’241 patent identify flavor precursors at different concentrations as producing different meat-like flavor and aroma profiles, the claimed minimum concentration of 1.5 mM of the sulfur compound must impart structural and functional differences that manifest in different flavors and aromas. Ex. M19, D.I. 114, 10 (citing ’241 patent, 20:7-35 (Example 1), 21:15-32 (Example 2)). Impossible’s interpretation of the ’241 patent specification is incorrect. A POSITA would understand that the examples provided in the ’241 patent only describe the concentration of these flavor precursors, including the sulfur compounds, in terms of their millimolar concentration as liquid solutions that are *added* to the food product and not the concentration of the flavor precursors in the end food product itself. This is evident because the ’241 specification uses millimolar units to describe the concentration of these flavor precursors, while the end food product (*e.g.*, meat replica patty) is a solid product, not a liquid. Hence, a POSITA would understand that while the high-level examples

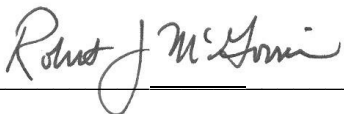
specify the molarity concentration of the flavor precursors used (*see, e.g.*, '241 patent, 20:7-35, 21:15-32), the specification is silent as to the *quantity* of the precursor added and a POSITA therefore could not discern whether, or at what quantity, the precursor might cause a structural and functional difference to the food product that, for instance, manifests itself as a change in flavor/aroma.

91. As noted above, I have reviewed the prosecution history of the '241 patent. Nothing in this prosecution history contradicts the opinions I have offered. In analyzing the patentability of the Molarity Term, the patent examiner focused only on whether the claimed compounds were present in the art, not their concentration before incorporation in the claimed product. *E.g.*, Ex. M20 (02/08/21 Final Rejection), 3-4; Ex. M21 (04/27/21 Notice of Allowance), 2-3. This supports my opinion that the Molarity Term, without more, is a process element that imparts no structural or functional differences to the claimed product.

X. CONCLUSION

92. I hereby declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Dated: June 28, 2023

A handwritten signature in cursive script, reading "Robert J. McGorin", is written over a horizontal line.

Dr. Robert McGorin

CERTIFICATE OF SERVICE

I hereby certify that on June 28, 2023, I caused the foregoing to be electronically filed with the Clerk of the Court using CM/ECF, which will send notification of such filing to all registered participants.

I further certify that I caused copies of the foregoing document to be served on June 28, 2023, upon the following in the manner indicated:

Ian R. Liston, Esquire
Jennifer A. Ward, Esquire
WILSON SONSINI GOODRICH & ROSATI, P.C.
222 Delaware Avenue, Suite 800
Wilmington, DE 19801
Attorneys for Plaintiff Impossible Foods Inc.

VIA ELECTRONIC MAIL

Matthew R. Reed, Esquire
WILSON SONSINI GOODRICH & ROSATI, P.C.
650 Page Mill Road
Palo Alto, CA 94304
Attorneys for Plaintiff Impossible Foods Inc.

VIA ELECTRONIC MAIL

Wendy L. Devine, Esquire
Susannah M. L. Gagnon, Esquire
Kristina Hanson, Esquire
Jessica Ramsey, Esquire
WILSON SONSINI GOODRICH & ROSATI, P.C.
One Market Plaza
Spear Tower, Suite 3300
San Francisco, CA 94105
Attorneys for Plaintiff Impossible Foods Inc.

VIA ELECTRONIC MAIL

Lorelei P. Westin, Esquire
WILSON SONSINI GOODRICH & ROSATI, P.C.
12235 El Camino Real
San Diego, CA 92130
Attorneys for Plaintiff Impossible Foods Inc.

VIA ELECTRONIC MAIL

/s/ Jeremy A. Tigan

Jeremy A. Tigan (#5239)