

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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MOTIF FOODWORKS, INC.,  
Petitioner,

v.

IMPOSSIBLE FOODS, INC.,  
Patent Owner.

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IPR2023-00206  
Patent 9,943,096 B2

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Before DONNA M. PRAISS, CHRISTOPHER M. KAISER, and  
JEFFREY W. ABRAHAM, *Administrative Patent Judges*.

PRAISS, *Administrative Patent Judge*.

JUDGMENT  
Final Written Decision  
Determining All Challenged Claims Unpatentable  
Denying-in-Part and Dismissing-in-Part Motion to Exclude  
*35 U.S.C. § 318(a)*

## I. INTRODUCTION

Motif FoodWorks, Inc. (“Petitioner”) filed a Petition requesting *inter partes* review of claims 1–12 and 14–24 (“the challenged claims”) of U.S. Patent No. 9,943,096 B2 (Ex. 1001, “the ’096 patent”). Paper 7 (“Pet.”). Impossible Foods, Inc. (“Patent Owner”) filed a Preliminary Response. Paper 8. Pursuant to 35 U.S.C. 314, we instituted *inter partes* review of the challenged claims on all grounds set forth in the Petition. Paper 23 (“Institution Decision” or “Inst. Dec.”).

After institution, Patent Owner filed a Patent Owner’s Response (Paper 34, “PO Resp.”), Petitioner filed a Reply (Paper 40, “Pet. Reply”), and Patent Owner filed a Sur-Reply (Paper 46, “PO Sur-Reply”). Patent Owner filed a motion to exclude a number of Exhibits (Paper 47, “Mot.”) which was opposed (Paper 48, “Opp.”) and the subject of a reply (Paper 49, “Reply to Opp.”). An oral hearing was held on April 3, 2024, and a transcript of the hearing is included in the record (Paper 54, “Tr.”).

We have jurisdiction under 35 U.S.C. § 6. After considering the parties’ arguments and supporting evidence, we conclude that Petitioner has proven by a preponderance of the evidence that claims 1–12 and 14–24 of the ’096 patent are unpatentable. 35 U.S.C. § 316(e).

## II. BACKGROUND

### A. *Related Matters*

The parties identify the following district court litigation as a related matter: *Impossible Foods, Inc. v. Motif FoodWorks, Inc.*, No. 22-cv-00311 (“the parallel District Court litigation”). Pet. 72; Paper 35, 1 (Patent Owner’s Updated Mandatory Notices). Patent Owner identifies as related matters the following *inter partes* review proceedings in which institution was denied:

IPR2022-00887 (US 10,863,761), IPR2023-00207 (US 11,224,241), IPR2023-00208 (US 11,013,250), and IPR2023-00209 (US 10,039,306). Paper 35, 1. Patent Owner additionally identifies as related matters the opposition proceeding in EP2943072, Petition to Accept Unintentionally Delayed Benefit Claims Under 37 C.F.R. § 1.78 (c) in U.S. Patent Application Ser. No. 13/941,211, filed July 12, 2012, and subsequent decision requesting clarifying information and dismissing Patent Owner’s Petition for a Certificate of Correction as moot. *Id.* at 1–2.

*B. The ’096 Patent*

The ’096 patent, titled “Methods and Compositions for Affecting the Flavor and Aroma Profile of Consumables,” seeks to provide “improved plant-based meat substitutes which better replicate the aromas and flavors of meat, particularly during and/or after cooking.” Ex. 1001, code (54), 1:60–62. According to the ’096 patent, existing meat substitute compositions are “extruded soy/grain mixtures which largely fail to replicate the experience of cooking and eating meat.” Ex. 1001, 1:46–48. The ’096 patent describes the common product limitations as “texture and mouthfeel that are more homogenous than that of equivalent meat products.” *Id.* at 1:49–51. Further, the ’096 patent explains that, because these products are “largely . . . sold pre-cooked, with artificial flavors and aromas pre-incorporated, they fail to replicate the aromas, flavors, and other key features . . . associated with cooking or cooked meat.” *Id.* at 1:52–55.

The ’096 patent describes combining one or more iron complexes, such as a heme-containing protein, with one or more flavor precursor molecules or compositions to “generate or provide a range of savory and meaty aromas and tastes . . . in a cooked consumable food product.” *Id.* at

2:43–50. According to the ’096 patent, the flavor precursor molecules or compositions can be added to uncooked food “in purified form and/or can be derived from ingredients in the uncooked consumable food product that contain and/or are enriched with one or more of the particular flavor precursors.” *Id.* at 2:50–54. The ’096 patent describes adding one or more flavor precursor molecules along with an iron complex to “an uncooked food product, before and/or during the cooking process.” *Id.* at 2:66–3:3.

According to the ’096 patent, “[c]onsumable food products . . . can be flavor additive compositions, e.g. for addition to another consumable food product before, during, or after its cooking process.” *Id.* at 3:32–35. The ’096 patent further describes the food flavor additive composition as not being limited in its form and that it “can be used to modulate the flavor and/or aroma profile for a variety of consumable food products.” *Id.* at 3:49–54.

### *C. Illustrative Claims*

Petitioner challenges claims 1–12 and 12–24. Pet. 1. Claim 1 and claim 10 are independent claims. Ex. 1001, 73:44–76:9.

Claims 1 and 10 are reproduced below.

1[pre] 1. A food flavor additive composition comprising:

1[a] a) an isolated heme-containing protein; and

1[b] 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

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

1[d] wherein the flavor additive composition contains no animal products; and,

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

Ex. 1001, 73:46–58 (paragraph numbering added as used in the Petition).

10[pre] 10. A food flavor additive composition prepared by a process of:

10[a] a) combining an isolated heme-containing protein;

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

10[c] a compound selected from cysteine, cystine, thiamine, methionine, and mixtures of two or more thereof, to form a heme flavor reaction mixture, and

10[d] b) heating the heme flavor reaction mixture to at least 150° C. for at least 1 minute to result in the food flavor additive composition;

10[e] wherein the food flavoring additive composition contains no animal products; and

10[f] wherein the heme flavor reaction mixture has a meaty flavor and/or meaty aroma during the heating of step b) and the food flavoring additive composition has a meaty flavor and/or meaty aroma after the heating of step b).

*Id.* at 75:8–25 (paragraph numbering added as used in the Petition).

*D. Asserted Grounds of Unpatentability*

Petitioner asserts the following grounds of unpatentability (Pet. 13–14):<sup>1</sup>

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<sup>1</sup> The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284

Claims Challenged	35 U.S.C. §	Reference(s)
1–5, 7–9, 23, 24	102	Brown <sup>2</sup>
1–12, 14–17, 20–24	103	Giacino, <sup>3</sup> Brown
18–19	103	Giacino, Brown, MacLeod <sup>4</sup>
1, 2, 4–7, 9–12, 14, 15, 20–24	103	Giacino, Conrad, <sup>5</sup> Crane <sup>6</sup>
3, 16	103	Giacino, Conrad, Crane, Proulx <sup>7</sup>
8, 17	103	Giacino, Conrad, Crane, Perret <sup>8</sup>
18, 19	103	Giacino, Conrad Crane, MacLeod
1–7, 9–12, 14–16, 20–24	103	Giacino, Proulx, Conrad

(2011) (“AIA”), amended 35 U.S.C. §§ 102 and 103. Without the benefit of provisional application No. 61/751,816, which Petitioner asserts fails to describe the full scope of the issued claims, i.e., the specifically claimed sugar and sulfur compounds (Pet. 5–10), the ’096 patent has an effective filing date of July 12, 2013, which is after March 16, 2013. Ex. 1001, code (60). Patent Owner does not dispute Petitioner’s priority date challenge (PO Resp. 5 n.1). Accordingly, patentability is governed by the versions of 35 U.S.C. §§ 102 and 103 after amendment by the Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112–29, 125 Stat. 284 (2011).

<sup>2</sup> WO 2013/010042 A1 (PCT/US/2012/046560), published Jan. 17, 2013 (Ex. 1012).

<sup>3</sup> US 3,519,437, issued July 7, 1970 (Ex. 1015).

<sup>4</sup> Glesni MacLeod and M. Seyyedain-Ardebili, *Natural and Simulated Meat Flavors (with Particular Reference to Beef)*, CRC Critical Reviews in Food Science and Nutrition, Thomas E. Furia, Ed., 14:4, 309–437, 1981 (Ex. 1024).

<sup>5</sup> US 4,818,557, issued Apr. 4, 1989 (Ex. 1013).

<sup>6</sup> US 2011/0287467 A1, published Nov. 24, 2011 (Ex. 1014).

<sup>7</sup> Amy K. Proulx and Manju B. Reddy, *Iron Bioavailability of Hemoglobin from Soy Root Nodules Using a Caco-2 Cell Culture Model*, J. Agric. Food Chem., 54, 1518–1522, 2006 (Ex. 1019).

<sup>8</sup> US 3,365,306, issued Jan. 23, 1968 (Ex. 1020).

Claims Challenged	35 U.S.C. §	Reference(s)
8, 17	103	Giacino, Proulx, Conrad, Perret
18, 19	103	Giacino, Proulx, Conrad, MacLeod

### III. ANALYSIS

#### A. Legal Standard

“A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.” *Verdegaal Bros., Inc. v. Union Oil Co. of Cal.*, 814 F.2d 628, 631 (Fed. Cir. 1987). “Inherent anticipation requires that the missing descriptive material is ‘necessarily present,’ not merely probably or possibly present, in the prior art.” *Trintec Indus., Inc. v. Top-U.S.A. Corp.*, 295 F.3d 1292, 1295 (Fed. Cir. 2002) (quoting *In re Robertson*, 169 F.3d 743, 745, (Fed. Cir. 1999)). “[T]he reference must not only disclose all elements of the claim within the four corners of the document, but must also disclose those elements arranged as in the claim.” *Sanofi-Synthelabo v. Apotex, Inc.*, 550 F.3d 1075, 1083 (Fed. Cir. 2008) (internal quotation marks omitted). In other words, it is not enough to be able to find all of the pieces of the claimed invention somewhere in a prior art reference; rather, those elements must be set out in the prior art reference in the same way they are in the claimed invention. *Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1369 (Fed. Cir. 2008) (“Because the hallmark of anticipation is prior invention, the prior art reference—in order to anticipate under 35 U.S.C. § 102—must not only disclose all elements of the claim within the four corners of the document, but must also disclose those elements ‘arranged as in the claim.’”

(quoting *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 1548 (Fed. Cir. 1983))).

A patent claim is unpatentable under 35 U.S.C. § 103 if the differences between the claimed subject matter and “the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) when in evidence, objective evidence of nonobviousness.<sup>9</sup> *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

*B. Level of Ordinary Skill in the Art*

In order to determine whether an invention would have been obvious at the time the application was filed, we consider the level of ordinary skill in the pertinent art at the critical time. *Graham*, 383 U.S. at 17. The resolution of this question is important because it allows us to “maintain[] objectivity in the obviousness inquiry.” *Ryko Mfg. Co. v. Nu-Star, Inc.*, 950

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<sup>9</sup> The Petition notes that unexpected results was asserted during prosecution regarding the combination of heme protein with ribose and cysteine compared to the same reaction conditions lacking the heme protein, however, such evidence is not coextensive with the scope of the claimed sulfur and sugar compounds. Pet. 66–67 (citing Ex. 1002, 237–38, 241–373). *See In re Peterson*, 315 F.3d 1325, 1329–31 (Fed. Cir. 2003) (Unexpected results must be commensurate in scope with the claims.). Patent Owner has not introduced objective evidence of non-obviousness in this proceeding.



F.2d 714, 718 (Fed. Cir. 1991). In assessing the level of ordinary skill in the art, various factors may be considered, including the “type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field.” *In re GPAC, Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (quotation omitted). Generally, it is easier to establish obviousness under a higher level of ordinary skill in the art. *Innovention Toys, LLC v. MGA Entm’t, Inc.*, 637 F.3d 1314, 1323 (Fed. Cir. 2011) (“A less sophisticated level of skill generally favors a determination of nonobviousness . . . while a higher level of skill favors the reverse.”).

Petitioner asserts that a person having ordinary skill in the art (referred to herein as “POSITA” or “POSA”) “would have (i) a Bachelor of Science degree in food science, biology, chemistry, microbiology, or a related discipline, and (ii) a Master of Science degree or Ph.D. in food science or at least three years of experience working as a food scientist” and “could also be part of a team of food scientists, including flavor chemists.” Pet. 5 (citing Ex. 1003 ¶¶ 42–47). Patent Owner does not offer an alternative definition of a person of ordinary skill in the art. PO Resp. 5 (“Patent Owner applies the level of ordinary skill in the art as proposed by Petitioner”). We apply Petitioner’s proposed definition because it is consistent with the problems addressed in the ’096 patent and the prior art of record. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (explaining that specific findings on ordinary skill level are not required “where the prior art itself reflects an appropriate level and a need for testimony is not shown”

(quoting *Litton Indus. Prods., Inc. v. Solid State Sys. Corp.*, 755 F.2d 158, 162 (Fed. Cir. 1985))).

C. *Claim Construction*

In an *inter partes* review proceeding based on a petition filed on or after November 13, 2018, a patent claim shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b) (as amended Oct. 11, 2018). This rule adopts the same claim construction standard used by Article III federal courts, which follow *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc), and its progeny. Under this standard, the words of a claim are generally given their “ordinary and customary meaning,” which is the meaning the term would have to a person of ordinary skill at the time of the invention, in the context of the entire patent including the specification. *See Phillips*, 415 F.3d at 1312–13. Only terms that are in controversy need to be construed, and then only to the extent necessary to resolve the controversy. *Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (“The Board is required to construe ‘only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.’” (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

In its Petition, Petitioner asserts that the claim terms “contains no animal products,” “food flavor additive composition,” and “a compound” do not require construction for purposes of this proceeding. Pet. 10–12. According to Petitioner, even if “no animal products” covers bovine myoglobin, which is native to an animal even when produced in engineered yeast, the grounds presented in the Petition are unaffected because the term

is alternatively mapped to a heme-containing protein native to plants. *Id.* at 11. Petitioner asserts the remaining terms each have a “plain meaning.” *Id.* at 11, 12.

In its Response, Patent Owner states that Petitioner advanced arguments in the parallel District Court litigation that are inconsistent with the positions that it takes in this proceeding. PO Resp. 6. Specifically, Patent Owner asserts Petitioner’s challenge based on Brown maps a protein to the recited “sulfur compound” in contravention of the District Court’s construction of the term “compound” which Petitioner had argued does not extend to proteins. *Id.* at 9–10 (citing Ex. 2019, 17–20; Ex. 2016, 9 (stating “the ‘sulfur compound’ limitation must be satisfied by a compound that is present separately from a protein”))).

The District Court’s claim construction for the term “compound” is shown below. Ex. 2016, 8–11.

Claim Term	District Court Construction
compound <sup>10</sup>	The “sulfur compound” limitation must be satisfied by a compound that is present separately from a protein; “compound” will not be construed as being limited to compounds used as flavor precursors

The District Court’s claim construction order cites to U.S. Patent 11,013,250 (the ’250 patent”) as representative of the ’096 patent and other related patents involved in the District Court litigation. *See* Ex. 2016, 7 (“Claim 1 of the ’250 patent claims is generally representative for purposes of the parties’ dispute.”). The District Court determined that plant proteins

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<sup>10</sup> Ex. 2016, 9, 11 (citing Ex. 1001, 15:26–27).

containing amino acids such as cysteine did not satisfy the “sulfur compound” claim limitation because both the claims and specification of the patent at issue “draw a distinction between ‘proteins’ and ‘sulfur compounds.’” *Id.* at 8. The District Court pointed to the separate disclosures of “plant proteins,” “non-protein substances,” and “sulfur compounds.” *Id.* at 9. Both parties agreed at trial that the Board should adopt the District Court’s claim construction in this *inter partes* review proceeding. Tr. 52:3–4 (“I would agree that the Board should adopt the district court construction.”) (Petitioner’s counsel), 64:8–9 (“The District Court adopted a construction. That construction should be applied here.”) (Patent Owner’s counsel). We agree. The District Court’s claim construction analysis applies equally to the ’096 patent which separately recites “protein” and “compound” in claim 1 and discloses sulfur compounds as non-protein substances. Ex. 2016, 8–9; Ex. 1001, 73:46 (“protein”), 73:51 (“compound”), 7:45–8:42 (describing the binding of a heme moiety to protein, non-peptidic polymer, or other macromolecule such as an iron chelating compound, and separately listing sulfur compounds as “molecules” in Table 1). For the purposes of this decision, we adopt the District Court’s claim construction. Ex. 2016 at 11, 18.

*D. Overview of the Asserted Art*

*1. Giacino (Ex. 1015)*

Giacino discloses “artificial meaty flavoring compositions and . . . processes for preparing them.” Ex. 1015, 1:19–20. Giacino discloses compositions which include cysteine and thiamine. *Id.* at 4:47–49, 4:49–53, 4:63–5:20. More specifically, Giacino teaches heating a mixture of taurine and thiamine “at an elevated temperature” and thereby creating “a reaction

mixture having a decided, marked meat flavor.” *Id.* at 1:60–64. Giacino’s product eliminates the previous need “to include cysteine in food flavor compositions,” although it permits the use of “small amounts of cysteine” to produce “beef flavors” rather than “pork or poultry” flavors. *Id.* at 4:47–53, 5:17–18. Giacino’s composition “can be used per se in a wide range of food stuffs, either as the dominant flavoring agent or as an aid in improving and enhancing existing flavor.” *Id.* at 1:65–67.

2. *Proulx (Ex. 1019)*

Proulx is non-patent literature that discloses the use of plant-derived soy leghemoglobin to fortify non-animal food products. Ex. 1019 Abs. Specifically, Proulx teaches that “heme iron from plant sources[, such as purified soy hemoglobin (LHb),] may be a novel value-added product that can provide highly bioavailable iron as a food fortificant.” *Id.* Proulx discloses that the “bioavailability of hemoglobin from soy root nodules [is] similar to that of heme iron from animal sources” and can “provide a unique alternative fortificant” and “improve the iron status of the population.” *Id.* at 1521.

3. *Conrad (Ex. 1013)*

Conrad discloses “a meat replacement product to be used in mixed minced meat products, process for its preparation, and meat products comprising same, whereby the meat replacement product comprises the gluten protein and the bran fractions of whole cereal grain,” and to which “a blood hemoglobin fraction can be added.” Ex. 1013, code (57). Conrad further discloses that “preferably the hemoglobin part [is] separated off from blood” and that “[t]he addition of blood/hemoglobin further gives a desired taste improvement as it improves the meat flavour of the final product.”

Ex. 1013, 4:7–9, 4:14–16.

4. *Perret (Ex. 1020)*

An object of Perret’s invention is to “provide for obtaining meatless beef-flavored foods.” Ex. 1020 1:66–68. Perret discloses “beef-flavored compositions” that include a “beef-flavored substance” made of cysteine or cystine and a reducing sugar along with other flavoring compounds.

Ex. 1020, 1:11–16, 2:1–3:2, 4:63–75, 5:52–57. Perret discloses compositions which include edible fat such as safflower oil. Ex. 1020, 4:6–29 (“With respect to the edible fat, both animal and vegetable fats may be used. For example, pork fat and beef fat, margarine, butter and safflower oil, and the like, can be employed.”).

5. *MacLeod (Ex. 1024)*

MacLeod also discloses science behind meat flavors and aroma, including chemical reactions that certain compounds can undergo in order to produce volatile compounds associated with a meaty aroma. Ex. 1003 ¶ 84. MacLeod discloses flavor adjuvants, including stabilizers, thickeners, flavorants, and flavor intensifiers. Ex. 1024, 110. MacLeod discloses the use of starch and pectin in meat-flavored compositions as thickeners. *Id.* MacLeod also discloses thickeners that include cellulose, gum arabic, and gelatin as carriers, binders, and emulsifiers. *Id.*

6. *Brown (Ex. 1012)*

Brown discloses a plant-based “meat substitute composition” that “accurately mimics the taste, texture, or color of a meat product derived from animal sources.” Ex. 1012 ¶ 6. In Brown’s compositions, “the characteristic flavor and fragrance components are mostly produced during the cooking process by chemical reactions involving one or more amino

acids, fats, peptides, nucleotides, organic acids, sulfur compounds, sugars and other carbohydrates.” *Id.* ¶ 362. Other “characteristic flavor and fragrance components are produced during the cooking process by chemical reactions catalyzed by the heme iron in a heme protein.” *Id.* ¶ 363. The compositions of Brown “may be visually similar to or indistinguishable from ground beef or a particular cut of beef.” *Id.* ¶ 272. In addition, the “[c]haracteristic flavor and fragrance components” of Brown are such that, “[i]n some embodiments” of Brown, “the olfactory map of the consumable during or after cooking is similar to or indistinguishable from that of cooked or cooking meat.” *Id.* ¶ 295. This “similarity [may be] sufficient to be beyond the detection threshold of human perception.” *Id.*

Brown’s “meat substitute product” comprises “a muscle replica; a fat tissue replica; and a connective tissue replica” that are “assembled in a manner that approximates the physical organization of meat.” *Id.* ¶ 189. The muscle replica component of Brown’s meat replica composition is described as follows: “[a] muscle replica comprising pea flour, sunflower oil, and glucose was heated for 10 minutes at 140C in the presence of either reduced leghemoglobin (LHb) or a mixture of iron (Fe<sup>3+</sup>)” and volatile “compounds found exclusively or more abundantly in the LHb samples are: 2-octanone, 2-methyl furan, which are often associated with the aroma of cooked meat.” *Id.* ¶ 364.

7. *Crane (Ex. 1014)*

Crane is directed to “methods of producing recombinant functional heme-binding proteins with complete heme incorporation and purified preparation of the same.” Ex. 1014, code (57). Crane states that heme-binding proteins “have diverse biological functions including, oxygen

transport, catalysis, active membrane transport, electron transport, and sensory.” *Id.* ¶ 21. Crane includes leghemoglobin among the “classes of heme-binding proteins” encompassed by the disclosure. *Id.* ¶ 21.

*E. Motion to Exclude*

Patent Owner moves to exclude certain exhibits on the basis that (1) the exhibits were not cited in Petitioner’s briefs and (2) the exhibits do not predate the ’096 patent’s effective filing date. We separately address these groups of exhibits below.

*1. Uncited Exhibits*

Patent Owner contends that the following exhibits should be excluded because they were not cited in the Petition or Reply: 1021, 1027, 1029–1032, 1034–1036, 1046–1047, 1049, 1056, 1060, 1064, 1073, 1082, 1084, 1087, 1095–1096, 1098–1101, 1107–1115, 1119–1120, 1123, 1133, 1135, 1137–1138, 1141, 1146–1147, 1149–1150, 1152, 1157–1159, 1180, and 1184. Mot. 1–2. Patent Owner contends that because these exhibits were not cited in the Petition or Reply, they cannot be relied on to establish unpatentability, are not relevant to the proceeding, and should be excluded. *Id.* (citing 37 C.F.R. §42.6(a)(3) (“Arguments must not be incorporated by reference from one document into another document.”); F.R.E. 401–402). Patent Owner contends that to the extent these uncited exhibits are deemed relevant, their admission would be unduly prejudicial, providing little support for this contention except to say that “delegating these exhibits exclusively to its expert declarations and forgoing any attempt to explain the relevance of these exhibits in its Petition or Reply, Petitioner is tasking the Board to play archaeologist with the record to determine how the exhibits support Petitioner’s position.” Reply to Opp. 2–3.



Petitioner asserts that, except for Exhibits 1082 and 1180, the challenged exhibits were cited and relied on by one or more of its experts, including Dr. Rodrigo Tarté, Dr. Robert McGorin, and Dr. Carl Batt. Opp. 3. Petitioner further contends that its exhibits, at least with regard to the exhibits cited by its experts, meet the low threshold for relevancy under Federal Rule of Evidence 401 given that Petitioner's experts relied on them in forming their opinions. Opp. 5.

Because we do not rely on these exhibits in this Final Written Decision, we dismiss Patent Owner's motion as it pertains to these exhibits as moot. *See* Trial Practice Guide 80 ("In the Board's experience, consideration of the objected-to evidence is often unnecessary to resolve the patentability of the challenged claims, and the motion to exclude is moot.").

## 2. *Post-Filing Date Exhibits*

Patent Owner further contends that the following exhibits should be excluded because they were improperly cited and relied upon as evidence of a person of ordinary skill's understanding at the time of invention: 1047, 1050, 1057, 1059, 1064, 1067, 1070, 1074, 1085, 1089, 1106, 1118, 1183, 1185, and 1187. Mot. 2–3. Patent Owner contends that each of these exhibits was publicly available after the priority date applied in the Petition. Mot. 3 (citing Ex. 1009 ¶¶ 231, 250–251, 254–255, 305, 340, 356, 381, 412, 433, 465, 551, 582); *see also* Pet. 5–6. Petitioner contends that the post-filing date exhibits

(1) are relied on by Petitioner to show inherent qualities/properties of various compounds and products and, thus, the exhibits' publication dates are irrelevant; (2) relate to arguments that PO has not contested to and . . . thus exclusion (which is not proper anyhow) is moot; and (3) are relied on in

addition to other exhibits for the same premise and hence their publication date merely goes to the weight of the evidence.

Opp. 2–3.

Post-filing evidence may be used to show the state of the art existing at the time of filing of the patent-at-issue. *See Plant Genetic Sys. N. V. v. DeKalb Genetics Corp.*, 315 F.3d 1335, 1344 (Fed. Cir. 2003). In addition, whether Petitioner’s post-filing evidence is sufficiently probative of the inherent chemical nature of compounds, or whether certain compounds could be obtained from non-animal sources, goes to the weight to be given the evidence, not its admissibility. Thus, we decline to exclude Exhibits 1047, 1050, 1057, 1059, 1064, 1067, 1070, 1074, 1085, 1089, 1106, 1118, 1183, 1185, and 1187.

#### *F. Unpatentability Grounds*

Petitioner’s ten (10) separately listed grounds challenging the patentability of the ’096 patent claims can be grouped under four (4) prior art references or combinations of prior art references. Pet. 13–14. The prior art reference groupings are:

- (1) Brown;
- (2) Giacino in view of Brown (and MacLeod);
- (3) Giacino in view of Conrad and Crane (and Proulx, Perret, or MacLeod); and
- (4) Giacino in view of Proulx and Conrad (and Perret or MacLeod).

In support of its unpatentability arguments, Petitioner relies on the declarations of Rodrigo Tarté, Ph.D. (Ex. 1003, the “Tarté Declaration”), Robert McGorin, Ph.D. (Ex. 1005), Carl Batt, Ph.D. (Ex. 1007), and Sylvia Hall-Ellis, Ph.D. (Ex. 1009). Patent Owner provides the declaration of Michael C. Qian, Ph.D. (Ex. 2030) in this proceeding to support its

arguments.

We address each of Petitioner’s grounds below by focusing on the fundamental four groupings of prior art references.

*1. Anticipation by Brown*

*a. Claim 1*

Petitioner contends that Brown anticipates claims 1–5, 7–9, 23, and 24. Pet. 20–26. Focusing on independent claim 1’s limitation “a compound selected from cysteine, cystine, thiamin, methionine, and mixtures of two or more thereof,” Petitioner asserts Brown’s disclosure of “pea flour” meets this limitation because “pea flour contains cystine, thiamine, and methionine.” *Id.* at 22–23 (citing Ex. 1012 (Brown) ¶ 364; Ex. 1003 (Tarte) ¶¶ 121–125; Ex. 1050/Ex. 1059 (Jahreis), 39, 41, 86; Ex. 1106, 3, 6–7). Petitioner qualifies that its mapping of “pea flour” to this claim limitation is based on the interpretation of “compound” as “not . . . limited to free compounds.” *Id.* at 22 n.7. Specifically, Petitioner states that the mapping is based on Brown’s “pea flour, which contains proteins having the claimed sugar and sulfur compounds.” *Id.* at 12; *see* Ex. 1003 ¶ 105 (reiterating this statement).

Brown states, in pertinent part, “[a] muscle replica comprising pea flour, sunflower oil, and glucose.” Ex. 1012 ¶ 364. Dr. Tarté states in his declaration that a person of ordinary skill “would have understood that pea flour includes cystine, methionine, and thiamine.” Ex. 1003 ¶¶ 121–125. On cross-examination, Dr. Tarté stated that this mapping to the claim is based on an understanding that Brown’s proteins satisfy the sulfur compound limitation. Ex. 2032, 33:19–34:12; 98:11–99.9 (“[I]n as much as . . . Patent Owner considers proteins to satisfy the sulfur compound claim, then . . . the

pea protein flour of Brown also satisfies the [sulfur] compound claim.”), 117:9–118:8. Patent Owner asserts that the Petition’s anticipation ground must fail if the claimed compound limitation does not extend to proteins. PO Resp. 13.

Because we adopt the District Court’s construction of the claim term “compound,” Petitioner’s contention that Brown anticipates the ’096 patent necessarily fails. *See Verdegaal Bros.*, 814 F.2d at 631 (“A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.”). Petitioner concedes that the viability of this ground depends on construing the term “compound” to include whole proteins, and has failed to present evidence in this proceeding that Brown discloses a sulfur compound that is separate from a protein. Tr. 50:21–52:13 (Petitioner’s counsel conceding that the anticipation ground is not viable under the District Court’s claim construction for “compound”). Thus, Petitioner has not shown by a preponderance of the evidence that claim 1 is unpatentable as anticipated by Brown.

b. *Claims 2–5, 7–9, 23, and 24*

Claims 2–5, 7–9, 23, and 24 likewise require “a compound selected from cysteine, cystine, thiamine, methionine, and mixtures of two or more thereof” based on their dependency from claim 1. Because Brown does not disclose a sulfur compound that is independent from a protein, it lacks all the necessary elements to anticipate the challenged ’096 patent claims. Thus, Petitioner has not shown by a preponderance of the evidence that claims 2–5, 7–9, 23, and 24 are unpatentable as anticipated by Brown for the same reasons as claim 1.

2. *Obviousness over Giacino, Conrad, and Crane*

Petitioner contends claims 1, 2, 4–7, 9–12, 14, 15, and 20–24 are unpatentable as obvious over Giacino, Conrad, and Crane; claims 3 and 16 are unpatentable as obvious over Giacino, Conrad, and Crane in further view of Proulx; claims 8 and 17 are unpatentable as obvious over Giacino, Conrad, and Crane in further view of Perret; and claims 18 and 19 are unpatentable as obvious over Giacino, Conrad, and Crane in further view of MacLeod. Pet. 44–57. Patent Owner disagrees. PO Resp. 36–50.

In our Institution Decision, we expressed concerns about whether Petitioner can establish that a POSITA would have had reason to modify Giacino’s meaty flavoring compositions by adding hemoglobin in view of Conrad, and further modify the combined teachings of Giacino and Conrad by replacing Conrad’s “hemoglobin . . . of whole blood from slaughtered animals” with Crane’s recombinant bovine hemoglobin in order to provide the “isolated heme-containing protein” required by claim limitations 1[a] and 10[a]. Inst. Dec. 34 (citing Pet. 46–50, 53). We also expressed concerns that the Petition does not adequately explain how Crane may be considered analogous art in view of its biological focus for producing recombinant heme-binding proteins. *Id.* at 34–35 (citing Ex. 1014, code (57), ¶ 21).

The analogous-art test requires a showing that a reference is either in the field of endeavor of the challenged patent or is reasonably pertinent to the problem with which the inventor was concerned in order to rely on that reference as a basis for unpatentability. *In re Oetiker*, 977 F.2d 1443, 1447 (Fed. Cir. 1992). Patent Owner argues that Petitioner fails to establish Crane as analogous art under this legal framework. PO Resp. 36–40; PO Sur-Reply 1–2.

First, Patent Owner asserts Crane is not “from the same field of endeavor” as the ’096 patent. *Id.* at 37 (citing Ex. 2030 (Qian Decl.) ¶ 86). Based on this record, the ’096 patent is directed to food products while Crane, on the other hand, relates to “methods for producing recombinant functional heme-binding proteins.” Ex. 1001, 1:22–25; Ex. 1014, code (57). As Patent Owner points out, Crane does not even mention food products or any flavor functionality of heme-binding proteins. PO Resp. 37. Petitioner does not address Crane’s field of endeavor in its Petition or Reply. *See* Pet. 36–50; Pet. Reply 1 (“Petitioner . . . relies on the arguments made in the Petition for Ground 1 and 3A–3D”). We agree with Patent Owner that Crane is not from the same field of endeavor as the ’096 patent.

Next, Patent Owner asserts the Petition fails to explain how Crane’s recombinant heme-binding protein is pertinent to the problem addressed by the ’096 patent inventors. According to Patent Owner, the problem solved by the inventors was “to provide meat-like-food products that overcome the limitations of prior-art meat substitutes.” PO Resp. 38. Crane, however, is directed to producing recombinant heme-binding proteins with complete heme incorporation. Ex. 1014 ¶¶ 3–5; Ex. 2030 ¶ 87. Neither Crane nor the Petition addresses how this is relevant to improving meat-associated flavors or aromas in food flavor additives. *See generally*, Ex. 1014; Pet. 36–50.

The Petition asserts that Crane’s recombinant heme-binding protein, if used in place of Conrad’s blood/hemoglobin, which is added to improve taste, “would have produced the proteins with a high degree of purity.” Pet. 47–48. The Petition asserts that the benefit of high purity is greater control over the amount added and consistency in the end product. *Id.* at 48.

However, the Petition does not establish sufficiently that this is a problem for food additives, let alone for Conrad's blood/hemoglobin.

In addition, the Petition does not establish sufficiently that Crane's recombinant heme-binding protein would have been expected to provide the same improved taste as Conrad's blood/hemoglobin to justify the substitution of one for the other. Crane describes the importance of complete incorporation of heme in recombinantly produced heme-binding proteins in terms of heme proteins' functions such as "electron transfer, transport and storage of oxygen, production and sensing of nitric oxide, decomposition of reactive oxygen species, catalytic oxidation of substrates, signal transduction and control of gene expression." Ex. 1014 ¶4. Crane further discloses "employing recombinant human hemoglobin as an oxygen delivery pharmaceutical" as an example of a commercial application where fully incorporated heme in recombinant proteins is important. *Id.* ¶7. Thus, based on the full record, we agree with Patent Owner's argument that Crane does not suggest that its recombinant proteins with fully incorporated heme provide a benefit to food product applications.

For all of the foregoing reasons, we agree with Patent Owner's analogous art arguments. Accordingly, we determine that the Petition's grounds based on the combination of Giacino, Conrad, and Crane necessarily fail because Crane is not analogous art.

### 3. *Obviousness over Giacino, Proulx, and Conrad*

Petitioner contends claims 1–7, 9–12, 14–16, and 20–24 are unpatentable as obvious in view of Giacino, Proulx, and Conrad; claims 8 and 17 are unpatentable as obvious in view of Giacino, Proulx, Conrad, and Perret; and claims 18 and 19 are unpatentable as obvious in view of Giacino,

Proulx, Conrad, and MacLeod. Pet. 57–66. Patent Owner disagrees.  
PO Resp. 50–53.

a. *Claim 1*

Petitioner asserts that every element of independent claims 1 and 10 is disclosed by Giacino except for “an isolated heme-containing protein.” Pet. 57. Petitioner provides two reasons why a POSITA would have been motivated to modify Giacino’s “meaty flavoring compositions” by adding an isolated heme-containing protein taught by Proulx and Conrad: (1) “to fortify the compositions[] with heme iron (as taught by Proulx)” and (2) to “enhance meaty flavor (as taught by Conrad).” *Id.* at 58, 61 (“Accordingly, whether to fortify the composition with heme iron **and/or** to enhance meat flavor, a POSITA would have been motivated to add soy leghemoglobin to Giacino’s compositions.”); Pet. Reply 22–23.

In the Sur-Reply, Patent Owner asserts that the Petition did not rely on Proulx and Conrad in the alternative and that Petitioner’s “shift” to a challenge based on Giacino and Proulx alone “represents an improper new ground.” PO Sur-Reply 23–24. Patent Owner directs us to the Petition’s listing of the grounds, which include Conrad in addition to Proulx, as well as the Petition’s reliance on Conrad’s heme-containing protein content for dependent claim 14, as support for its position. *Id.* at 23 (citing Pet. 14, 37, 57, 65).

We agree with Petitioner that the Petition presents the combination of Giacino and Proulx alone, the combination of Giacino and Conrad alone, and the combination of Giacino and Proulx together with the further teachings of Conrad. Pet. Reply 22; *see* Pet. 58 (separately stating for each prior art reference the reason for adding a heme-containing protein), 61



(“Accordingly, whether to fortify the composition with heme iron *and/or* to enhance meat flavor, a POSITA would have been motivated to add soy leghemoglobin to Giacino’s compositions.”). The Petition provides separate paragraphs explaining the reasoning for modifying Giacino, introducing the reasoning supported by Proulx as “First” and introducing the reasoning supported by Conrad as “Second.” Pet. 58–60. After separately explaining each rationale for modifying Giacino, the Petition reiterates that the asserted motivation from Conrad is both an “additional” one and a “separate” one from the asserted motivation provided by Proulx. Pet. 61 (“Hence, a POSITA would have been motivated to include soy leghemoglobin in Giacino’s compositions for the additional (and separate) reason of improving their flavor profile.”). Therefore, we focus our discussion on whether the Petition provides sufficient reasoning for modifying Giacino with the addition of a heme-containing protein from Proulx, Conrad, or both.

The record supports Petitioner’s position that Giacino discloses a “food flavor additive composition.” Ex. 1015, 1:19–25 (“This invention relates to novel artificial meaty flavoring compositions . . . and to novel food compositions containing them.”). The compounds required by claim 1(b) are present in Giacino’s composition, namely “saccharide material such as a mono saccharide [sic],” including “[r]ibose, sucrose [sic], dextrose, and xylose,” which are added to Giacino’s composition to provide “somewhat more intense flavor characteristics.” Ex. 1015, 6:1–7; Ex. 1003 ¶ 199. The compounds required by claim 1(c) are also present in Giacino’s flavoring compositions, namely thiamine, cysteine, or cystine. Ex. 1015, 2:5–8, 2:14–16, 3:43–46; 3:75–4:3, 4:21–23, 5:1–10; Ex. 1003 ¶ 199. Regarding claim 1’s requirement that the composition contain “no animal products,”

Giacino discloses that for a hydrolyzed protein ingredient, non-animal vegetable hydrolysates, such as those obtained from corn, wheat, yeast, and the like, are preferred. Ex. 1015, 3:23–25.

The record also supports Giacino’s disclosure of claim 1’s requirement that cooking the composition results in “at least two volatile compounds which have a meat-associated aroma.” Giacino discloses that heating the composition leads to a reaction that produces a meaty flavor. Ex. 1015, 6:15–17 (“The meat flavor of the compositions of the present invention is developed by heating the pre-mix compositions at an elevated temperature for a period of time.”); *id.* at 2:5–8, 6:20–23; Ex. 1003 ¶¶ 208–209; Ex. 1005 ¶ 27. Both Petitioner’s expert, Dr. McGorin, and Patent Owner’s expert, Dr. Qian, agree that the terms “aroma” and “flavor” can be used interchangeably in flavor chemistry research. Ex. 1005 ¶ 27 (“In flavor chemistry research, the terms ‘aroma’ and ‘flavor’ are often used interchangeably in recognition of the dominant contribution of aroma to total flavor.”); Ex. 1182, 41:11–22 (“Yes, I agree [with Dr. McGorin’s statements in paragraph 27]”). Both parties’ experts also agree that a POSITA would have understood from Giacino’s disclosure that at least two volatile compounds associated with a meat flavor or aroma are generated. Ex. 1182, 44:5–23 (Dr. Qian agrees that at least two volatiles are associated with meat aroma); Ex. 1182, 47:4–25, 48:1–25 (Dr. Qian confirms Giacino heats precursors at an elevated temperature whereby a reaction takes place and a meaty flavor is developed); Ex. 1182, 48:1–25 (Dr. Qian states that meat aroma comprises “[v]ery likely” more than two volatile compounds); Ex. 2032, 63:11–64:22 (Dr. Tarté states that “heating [Giacino’s] composition . . . would generate volatiles[,] [w]hich are responsible for the

[meaty] flavor”). Thus, the preponderance of the evidence supports Petitioner’s assertion that Giacino discloses all limitations of claim 1 except for the “isolated heme-containing protein” required by claim 1(a).

There is no dispute that both Proulx and Conrad disclose isolated heme-containing protein. Pet. 57; Ex. 1019 (Proulx), Abs., 1518, 1520; Ex. 1013 (Conrad), 4:14–16; Ex. 1003 (Tarté) ¶¶ 386, 393, 410–411; PO Resp. 36 (“Conrad’s animal blood having hemoglobin”), 51 (“Proulx’s ‘soy leghemoglobin’”). Instead, Patent Owner challenges the asserted reason for combining Giacino with Proulx’s soy leghemoglobin on the basis of improving the nutritional content of Giacino’s additive, asserting that flavor additives are meant to impart flavor rather than nutrition. PO Resp. 50–51 (citing Ex. 2030 ¶¶ 44–47, 93, 101; Ex. 1038, 139–40). Patent Owner also asserts that this ground merely alters the ground based on Giacino, Conrad, and Crane by substituting Proulx for Crane and, thus, fails for the same reasons that Giacino, Conrad, and Crane fail, namely, the Petition “does not explain why a [POSITA] already seeking to add Conrad’s blood to improve upon the meat flavor of Giacino’s compositions, would seek to further replace that blood for [Proulx’s] ‘improved bioavailability of heme iron.’” *Id.*

In the Sur-Reply, Patent Owner asserts that even if the combination of Giacino and Proulx alone is considered, a POSITA “would not have viewed an ingredient’s nutritional content alone as a motivation for modifying flavor additives like Giacino.” PO Sur-Reply 23–24. Patent Owner asserts that the significant function of a flavor additive is its flavor, not nutritional contribution. *Id.* at 24 (citing PO Resp. 50–51; Ex. 2030 ¶¶ 44–47, 93, 101; Ex. 1038, 139–140). Regarding Petitioner’s evidence that a flavor additive

can also have nutritional value, e.g., salt and garlic, Patent Owner asserts that “an ingredient’s *flavor* is what is considered . . . with any nutritional value added by that ingredient being a bonus.” *Id.* at 25–26.

Petitioner contends that a POSITA would have been motivated to utilize Proulx to mimic the beneficial aspects of the nutritional content of meat, by adding isolated soy leghemoglobin as taught by Proulx, given that Giacino’s compositions are not a significant source of iron, including heme iron. Pet. 58–59. Petitioner further contends that a POSITA would have recognized that a non-animal source of heme iron, such as Proulx’s soy leghemoglobin, obviates the need to rely on heme-containing proteins obtained from animals, appealing to consumers for health, environmental, or personal reasons. Pet. 61. Petitioner contends that a POSITA would have had a reasonable expectation of success in modifying Giacino to achieve the claimed invention, and that only ordinary skill is required to implement the teachings of the references, including Proulx’s process steps for harvesting and isolating soy leghemoglobin. Pet. 61 (citing Ex. 1003 ¶¶ 401–402).

Regarding motivation to combine Giacino, Proulx, and Conrad, Patent Owner contends that “Conrad already includes hemoglobin and Petitioner does not explain why a [POSITA], already seeking to add Conrad’s blood to improve upon the meat flavor of Giacino’s compositions, would seek to further replace that blood [with Proulx] for ‘improved bioavailability of heme iron.’” PO Resp. 50–51. Patent Owner contends that Petitioner’s ground based on the combination of Giacino, Proulx, and Conrad “swaps out Crane for Proulx and asserts the *same rationale* . . . in Ground 3A.” PO Resp. 50; Ex. 2030 ¶ 100 (emphasis added). Patent Owner asserts that Petitioner introduced an improper new ground in its Reply for numerous

reasons, including Petitioner’s assertion that “Conrad is unnecessary to the ground.” PO Sur-Reply 23–24 (citing Pet. Reply 23–24).

Petitioner contends that Patent Owner is mistaken that Petitioner’s ground based on the combination of Giacino, Proulx, and Conrad “swaps out Crane for Proulx and asserts the same rationale for combining the references” as Ground 3A (Ground 3A referring to the combination of Giacino, Conrad, and Crane). Pet. Reply 24. (citing PO Resp. 50). Instead, Petitioner notes that it has provided two distinct reasons why a person of ordinary skill would have been motivated to add Proulx’s leghemoglobin to Giacino: (1) iron fortification/nutritive benefits as disclosed by Proulx; (2) improved meat flavor as disclosed by Conrad. Pet. Reply 23 (quoting Pet. 61 (“Accordingly, whether to fortify the composition with heme iron *and/or* to enhance meat flavor, a POSITA would have been motivated to add soy leghemoglobin to Giacino’s compositions.”)); *see also* Pet. Reply 23 (quoting Pet. 61 (“Hence, a POSITA would have been motivated to include soy leghemoglobin in Giacino’s compositions for the *additional (and separate)* reason of improving their flavor profile.”)). Petitioner contends that, unlike the combination of Giacino, Conrad, and Crane, the combination of Giacino, Proulx, and Conrad is not “predicated on adding Conrad’s hemoglobin to Giacino’s composition and then replacing that hemoglobin with another similar compound” but, instead, adding “Proulx’s isolated leghemoglobin to Giacino’s compositions in the *first instance* to fortify Giacino’s compositions with heme iron.” Pet. Reply 24 (citing Pet. 58–60; Ex. 1003 ¶¶ 390–394, 402, 407–412).

The record supports Petitioner’s challenge to claim 1 based on the modification of Giacino with Proulx. Proulx teaches that heme iron from

plant sources (including soy leghemoglobin) can be added to food to fortify it with highly bioavailable iron. Ex. 1019, 1518 (describing heme iron from plant sources as “a food fortificant”). Thus, Petitioner asserts a POSITA would recognize two separate motivations to add soy leghemoglobin to a food (1) iron fortification/nutritive benefits as disclosed by Proulx; and (2) improved meat flavor as disclosed by Conrad. Pet. Reply 22–23. We determine that Petitioner’s reliance on the Proulx-disclosed reason to combine is sufficient, so we need not reach the alternative reason disclosed in Conrad. *See Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1372–73 (Fed. Cir. 2019) (In a final written decision from an IPR proceeding, the Board was not required to reach a reason to combine a prior art reference which the petition presented as an alternative.).

Regarding the reason to modify Giacino with Proulx’s teaching, Patent Owner contends that “[n]othing in Giacino suggests that the purpose of its flavor additives is to also provide nutritional content to a food product,” therefore, Petitioner’s reasoning lacks support. PO Resp. 50–51 (citing Ex. 2030 ¶¶ 44–47, 93, 101; Ex. 1038, 139–140). Patent Owner also contends that the function of a flavor additive is to provide flavor, not nutrition, and Proulx does not describe leghemoglobin as imparting any beneficial flavor to a flavor additive. PO Sur-Reply 24–26.

Patent Owner further asserts that Petitioner provides no basis for a POSITA to reasonably expect that the addition of Proulx’s soy leghemoglobin would provide “acceptable organoleptic properties.” PO Resp. 51 (citing Ex. 2030 ¶¶ 38–40, 75–80); PO Sur-Reply 26 (citing Ex. 2030 ¶ 76). According to Patent Owner’s expert, iron is a known catalyst of oxidation from which rancid or stale flavors are developed and myoglobin

is readily broken down during the cooking process to release iron. Ex. 2030 ¶¶ 39–40. Patent Owner’s expert states that thermal lipid oxidation can form desirable meaty aromas, but the products of autoxidation, which is often iron catalyzed, can differ from the products of thermal lipid oxidation and occur without heat during storage or after cooking. *Id.* ¶¶ 38, 79–80.

Petitioner contends that Proulx, rather than Giacino, would have motivated a person of ordinary skill to add leghemoglobin to Giacino’s compositions to “fortify them with heme iron, which would encourage consumers to eat foods, such as meat substitutes, made with Giacino’s fortified compositions.” Pet. Reply 25 (citing Pet. 59; Ex. 1003 ¶¶ 410–411). Petitioner contends that Proulx teaches a known technique for fortifying a consumable product with heme iron, and that Patent Owner does not dispute that the technique could be used to fortify Giacino’s compositions in the same way to achieve a similar result. Pet. Reply 26 (citing PO Reply 50–51; Pet. 61). Petitioner maintains that Giacino discloses every limitation of the independent claims except the “isolated heme-containing protein.” *See, e.g.*, Pet. 26, 57.

Upon review of the parties’ arguments, supporting evidence, and argument at trial, we do not agree with Patent Owner that Petitioner’s basis for improving the nutritional content of the food product of Giacino is unsupported by the record. Proulx identifies iron deficiency as “a major nutritional problem, affecting over 2 billion people[.]” Ex. 1019, 1518; Ex. 1003 ¶ 93; *see also* Pet. Reply 25. Based on the evidence in this record, Giacino’s compositions lack a significant source of iron. Ex. 1003 ¶¶ 387, 407. Furthermore, like Proulx, Giacino’s composition is intended to be an additive to food products. Specifically, Giacino’s composition is intended to

be added to synthetic meat fibers, that may benefit from a source of iron, by mimicking not only the “meaty flavor” or aroma of meat, but the nutritional profile of conventionally sourced beef as well. Ex. 1003 ¶ 410; Ex. 1015, 7:22–26. This reasoning is supported by Petitioner’s expert, Dr. Tarté. Ex. 1003 ¶ 410. Patent Owner acknowledges the nutritive aspect of the addition is a “bonus” to the flavor impact. PO Sur-Reply 25–26. Proulx explicitly teaches adding leghemoglobin as an additive to food (“food fortificant”), therefore a POSITA would have had a reasonable expectation of success in doing so. Ex. 1019, Abs.; *see id.* at 1521 (“added with tortillas”).

Even if the addition of Proulx’s leghemoglobin were to produce autooxidation and impact Giacino’s meaty flavor, the benefit of Proulx’s leghemoglobin as an additive to a food composition is not disputed and supports the combination. “The fact that the motivating benefit comes at the expense of another benefit, however, should not nullify its use as a basis to modify the disclosure of one reference with the teachings of another. Instead, the benefits, both lost and gained, should be weighed against one another.” *Winner Int’l Royalty Corp. v. Wang*, 202 F.3d 1340, 1349 n.8 (Fed. Cir. 2000). *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006) (“a given course of action often has simultaneous advantages and disadvantages, and this does not necessarily obviate motivation to combine”). Moreover, the evidence of record regarding the asserted negative effect on aroma and flavor due to heme proteins is that this negative impact is merely a possibility. Ex. 2030 ¶ 76 (Dr. Qian states that heme proteins have an “unpredictable effect” and refers to statements made in related patent prosecution that “fortification [with] iron has a potential negative



effect on organoleptic quality of maize products, in that soluble forms of iron can cause oxidative rancidity,” quoting Ex. 1148, 2715). Based on the evidence of record, the benefit of adding heme protein taught by Proulx outweighs the potential negative effect that it may have on Giacino’s flavoring additive. Thus, the preponderance of the evidence in this record supports Petitioner’s assertion that a POSITA would have been motivated to nutritionally fortify Giacino’s meat flavoring composition by adding Proulx’s soy leghemoglobin.

Regarding a reasonable expectation of success from the combination, Patent Owner contends that Petitioner “points to no basis in the references that a [POSITA] would have reasonably expected Proulx’s ‘soy leghemoglobin’ would result in a flavor composition having acceptable organoleptic properties.” PO Resp. 51 (citing Ex. 2030 ¶¶ 38–40, 75–80). Petitioner contends that (1) Giacino’s compositions do not require lipids, and would therefore not result in lipid oxidation; (2) lipid oxidation was known to provide beneficial flavor and takes time to develop; and (3) intact heme-proteins were not known to cause off-flavors. Pet. Reply 27 (citing Ex. 1181 ¶¶ 110–111); *see* Ex. 1181 ¶¶ 60–70.

Upon review of the parties’ arguments and supporting evidence, we do not agree with Patent Owner that Petitioner “points to no basis in the references that a [person of ordinary skill] would have reasonably expected Proulx’s ‘soy leghemoglobin’ would result in a flavor composition having acceptable organoleptic properties.” PO Reply 51. The McGorin Declaration does not support Patent Owner’s contention that leghemoglobin is believed to adversely affect aroma and flavor. First, the McGorin Declaration does not address leghemoglobin specifically, but, rather, meat

flavor chemistry. Ex. 1005 ¶ 26. Second, regarding undesirable flavors, the McGorin Declaration states “[a]lthough heme-proteins can promote lipid oxidation and undesirable flavors in meat and other products *over time*, lipid oxidation contributes to a desirable meaty aroma upon initial cooking.”

Ex. 1005 ¶ 16.

The preponderance of the evidence supports Petitioner’s rationale for combining the teachings of Giacino and Proulx and that a POSITA would have had a reasonable expectation of success resulting from iron fortification of a meat flavoring composition with leghemoglobin. Accordingly, Petitioner has shown by a preponderance of the evidence that claim 1 would have been obvious over the combination of Giacino, Proulx, and Conrad.

b. *Claim 10*

Claim 10 is independent and shares all aspects of claim 1 except for the temperature and time ranges over which the composition is heated. Ex. 1001, 75:8–25 (“heating the heme flavor reaction mixture to at least 150 C. for at least 1 minute to result in a food flavor additive composition . . .”). For this limitation, the Petition relies on Giacino’s disclosure to heat compositions to 200° F (93° C) and 420° F (216° C) for between 15 seconds and 6 hours, which overlap with the claimed ranges. Pet. 64, 38 (citing Ex. 1015, 6:26–31). Petitioner also relies on Giacino’s disclosure that temperatures between 250° F (121° C) and 400 F (204° C) and heating times between 15 seconds and 3 minutes are preferred for heat exchangers which can bring the reaction mixture quickly to the reaction temperature and then quickly cooled in a second exchanger to lower temperature at which no further reaction takes place. *Id.* at 38–39 (citing Ex. 1015, 6:48–52, 6:68–71,

Ex. 1003 ¶ 244). The record supports the asserted overlap in time and temperature disclosed by Giacino.

Patent Owner does not address Petitioner's arguments with respect to claim 10, beyond arguments discussed above with respect to independent claim 1, which we determine are unavailing for the reasons discussed above in connection with claim 1. PO Resp. 52.

Upon review of the parties' arguments and supporting evidence, we determine that Petitioner demonstrates by a preponderance of the evidence that independent claim 10 would have been obvious over the combined disclosures of Giacino, Proulx, and Conrad.

*c. Claims 2–7, 9, 11–12, 14–16, and 20–24*

Claims 2–7, 9, 23, and 24 depend from claim 1, and claims 11, 12, 14–16, and 20–22 depend from claim 10. Ex. 1001, 73:59–76:49. In addition to the evidence and arguments presented for independent claims 1 and 10, Petitioner directs us to other portions of the Petition that identify support for the further limitations of claims 2–7, 9, 11–12, 14–16, and 20–24 in Giacino (Ex. 1015), Proulx (Ex. 1019), or the Tarté Declaration (Ex. 1003). Pet. 62–66 (citing Ex. 1003 ¶¶ 424–426, 429, 444–445, 447–448, 450); *see also* Ex. 1003 ¶¶ 214–230, 235–238, 252–260, 273–280.

Patent Owner does not address Petitioner's arguments with respect to claims 2–7, 9, 11–12, 14–16, and 20–24, beyond arguments discussed above with respect to independent claim 1 and independent claim 10. PO Resp. 52; PO Sur-Reply 23–26.

Upon review of the parties' arguments and supporting evidence, we determine that Petitioner demonstrates by a preponderance of the evidence

that dependent claims 2–7, 9, 11–12, 14–16, and 20–24 would have been obvious over the combined disclosures of Giacino, Proulx, and Conrad.

Dependent claims 2 and 15 require that “the heme-containing protein is selected from the group consisting of . . . leghemoglobin.” Ex. 1001, 73:59–63, 76:1–5. The record supports Petitioner’s assertion that a POSITA would have added Proulx’s leghemoglobin, which is a heme-containing protein, to Giacino’s meaty flavoring composition “to create a meat-flavored composition that closely mimics the attributes of conventionally sourced meat, including flavor, aroma, and beneficial nutritional aspects,” thus satisfying these claims. Pet. 58; *see id.* at 58–62; Ex. 1003 ¶¶ 309, 391–394, 397, 398, 401–403, 407, 408–411, 424; Ex. 1019, Abs., 1518, 1520, 1522; Ex. 1015, 1:51–59.

Dependent claims 3 and 16 require that “the heme-containing protein comprises amino acid sequence having at least 80% sequence identity to a polypeptide set forth in SEQ ID Nos: 1-26.” Ex. 1001, 74:45–48, 76:11–14. The record supports Petitioner’s assertion that adding Proulx’s soy leghemoglobin to Giacino’s meaty flavoring composition satisfies these claims because SEQ ID NO 4 identifies the polypeptide for Glycine max leghemoglobin (soy leghemoglobin). Pet. 62; *see id.* at 59–60; Ex. 1003 ¶¶ 425–426 (citing Ex. 1001, 10:23–24); Ex. 1019, 1519–20.

Dependent claim 4 requires that “the food flavor additive composition is a powder or a liquid composition.” Ex. 1001, 74:49–51. Dependent claim 24 requires that the flavor additive composition be “in the form of . . . a bouillon powder, bouillon cube, flavor packets or seasoning packet.” *Id.* at 76:47–49. The record supports Petitioner’s assertion that Giacino’s flavoring composition may be a spray dried powder, such as bouillon

powder, or a liquid composition. The record also supports Petitioner's assertion that it would have been obvious to package the powders in seasoning or flavoring packets. Pet. 63; *see id.* at 35; Ex. 1003 ¶¶ 220–223; Ex. 1015, 2:5–8, 2:23–28, 6:36–39, 9:70–10:2.

Dependent claim 5 requires that “the heme-containing protein is a plant . . . heme-containing protein.” Ex. 1001, 74:52–53. The record supports Petitioner's assertion that Proulx's leghemoglobin is a plant heme-containing protein. Pet. 63; *see id.* at 59; Ex. 1003 ¶ 429; Ex. 1019, Abs.

Dependent claim 6 requires that the flavor additive composition comprise “a soy protein hydrolysate.” Ex. 1001, 75:55–58. Dependent claim 7 requires that the food flavor additive composition comprise “one or more of a compound selected from . . . glutamic acid, glycine, thiamine.” Ex. 1001, 74:60–65. Dependent claim 9 requires that the flavor additive composition comprise “one or more of albumin or a globulin.” *Id.* at 75:6–7. Dependent claim 22 requires that the flavor additive composition comprise “one or more of . . . a soy protein hydrolysate.” *Id.* at 76:36–40. The record supports Petitioner's assertion that Giacino discloses that its composition comprises an edible protein hydrolysate, preferably a vegetable protein hydrolysate, and thiamine, glutamic acid, and/or glycine. Pet. 63; *see id.* at 36; Ex. 1003 ¶¶ 226, 229; Ex. 1015, 2:5–8, 3:3–5, 3:18–25, 4:18–21, 5:1–10.

Dependent claim 11 requires that the flavor additive composition “comprises a compound selected from the group consisting of . . . 2, 5-dimethylpyrazine and 2-methylthiazole.” Ex. 1001, 75:26–36. The record supports Petitioner's assertion that heating cysteine and ribose, which Giacino discloses in its composition, produces, on heating, volatile

compounds including 2, 5-dimethylpyrazine and 2-methylthiazole. Pet. 64; *see id.* at 16, 32, 39–40; Ex. 1003 ¶¶ 85, 253, 444–445; Ex. 1015, 4:18–21, 5:1–10, 6:1–5.

Dependent claim 12 requires that “the compound is detectable in the headspace above the heme flavor reaction mixture during . . . heating.” Ex. 1001, 75:37–41. The record supports Petitioner’s assertion that Giacino’s composition produces volatiles that are released in the air above the meaty flavoring composition, i.e. the composition’s headspace. Pet. 64–65; Ex. 1003 ¶¶ 447–448.

Dependent claim 14 requires that “the heme-containing protein is present in an amount between about 0.01% and about 5% by weight in the heme flavor reaction mixture. Ex. 1001, 75:47–50. The record supports Petitioner’s assertion that it would have been obvious to a POSITA to have added Proulx’s soy leghemoglobin to Giacino’s meaty flavoring composition in an amount that overlaps the claimed range. Pet. 54–55 (citing Ex. 1013, 4:33–40; Ex. 1003 ¶¶ 359–370). Petitioner asserts that a POSITA would have recognized that the concentration of heme-containing protein would be adjusted as part of routine experimentation to optimize the balance between flavor and nutritional content. *Id.* at 54–55; Ex. 1003 ¶¶ 371–372.

Dependent claim 20 requires that “the heme flavor reaction mixture is an aqueous solution.” Ex. 1001, 76:30–32. Dependent claim 21 requires that “the heme flavor reaction mixture is an oil-based mixture.” Ex. 1001, 76:33–35. The record supports Petitioner’s assertion that Giacino discloses that its compositions can be either aqueous solutions or in an edible oil-based vehicle containing up to 95% oil as a medium. Pet. 65; *see id.* at 43–44; Ex. 1015, 2:23–28 (“[I]t is . . . preferred to incorporate . . . a vehicle which

includes . . . water, edible oils . . . to provide a medium for the reaction.”), 6:36–39 (“[B]eef flavor compositions involve[] refluxing an aqueous pre-mix.”), 5:22–30 (“The vehicle may constitute as much as 95 percent by weight or more.”); Ex. 1003 ¶¶ 274–275.

Dependent claim 23 requires imparting a meaty flavor and/or aroma to a consumable food product by “adding to the consumable food product a food flavor additive composition of claim 1; and heating . . . after the adding step.” Ex. 1001, 76:41–46. The record supports Petitioner’s assertion that Giacino discloses adding its flavoring compositions to consumable food products, such as soups, gravies, and synthetic meats, to impart a meaty flavor/aroma, which food products a POSITA would have understood to be subsequently heated or cooked. Pet. 65–66; *see id.* at 44 (citing Ex. 1015, 6:71–7:2; Ex. 1003 ¶¶ 278–279).

d. *Claims 8 and 17*

Claim 8 depends from claim 1 and requires the composition comprise “one or more of an oil selected from . . . safflower oil.” Ex. 1001, 74:66–75:1. Claim 17 depends from claim 10 and similarly requires that the composition “comprises one or more oils selected from . . . safflower oil.” *Id.* at 76:14–17. Petitioner asserts that claims 8 and 17 are unpatentable under 35 U.S.C. § 103 over the combination of Giacino and Proulx as discussed above in connection with claims 1 and 10, in further view of Perret’s disclosure of using safflower oil as an edible oil medium for Giacino’s compositions. Pet. 63 (citing Ex. 1003 ¶ 432; Ex. 1020, 4:6–29).

More particularly, Petitioner asserts that Perret discloses simulated meat flavoring compositions that provide a meaty aroma/flavor, and include edible fat such as safflower oil. Pet. 63 (citing Pet. 52). Petitioner contends

that a POSITA would have been motivated to use Perret's safflower oil for Giacino's "edible oils" because Perret teaches that such fat leads to a "very pleasing product" having a "roast meat flavor and odor." Pet. 63 (citing Pet. 53; Ex. 1020, 4:6–29). Petitioner further contends that it would have been obvious to try Perret's safflower oil due to the finite number of edible oils, and that a POSITA would have had a reasonable expectation of success adding safflower oil since no more than routine skill would have been required. Pet. 63 (citing Pet. 52–53; Ex. 1003 ¶¶ 338–339).

Patent Owner does not address Petitioner's arguments with respect to claims 8 and 17, beyond the arguments it presents with respect to independent claim 1 and independent claim 10. PO Resp. 49, 52; Ex. 2030 ¶ 105 ("The addition of Perret as a reference does not alter the non-obviousness of claims 1 or 10, and thus dependent claims 8 and 17.").

Based on the foregoing, we determine that Petitioner demonstrates by a preponderance of the evidence that claims 8 and 17 would have been obvious over the combined disclosures of Giacino, Proulx, Conrad, and Perret.

*e. Claims 18 and 19*

Dependent claims 18 and 19 depend from claim 10; claim 18 requires that the flavor additive composition comprise an "an ingredient selected from an emulsifier and a gelling agent to the heme flavor reaction mixture prior to . . . heating" and claim 19 requires that the flavor additive composition comprise "adding an emulsifier and a gelling agent to the heme flavor reaction mixture prior to . . . heating." Ex. 1001, 76:23–29. Petitioner asserts that claims 18 and 19 are unpatentable under 35 U.S.C. § 103 over the combination of Giacino and Proulx as discussed above, in further view



of MacLeod's disclosure of using a gelling agent to thicken Giacino's compositions and/or promote gelling.

More particularly, Petitioner contends that it would have been desirable for certain applications of Giacino's flavoring compositions, including gravies, sauces, and synthetic meat fibers, to include an emulsifier and a gelling agent to approximate the consistency of these food products. Pet. 65 (citing Pet. 55; Ex. 1003 ¶¶ 374–377). Petitioner contends that Giacino invites such modification because it discloses incorporating food additives including thickeners and starches. Pet. 65, 55–56, 41–42 (citing Ex. 1015, 9:5–19, 9:11:13). Petitioner further contends that a person of ordinary skill would have added an emulsifier, such as gum arabic as taught by Giacino, and a gelling agent, such as pectin or starch as taught by MacLeod, to Giacino's compositions before the heating step because the heat would activate the gelling agent's desired properties, assist in increasing the fluidity of the mixture, and help disperse the emulsifier and gelling agent throughout the mixture. Pet. 65, 56, 42–43; Ex. 1003 ¶¶ 269–271; Ex. 1134, 249; Ex. 1136, 114, 124.

Patent Owner does not address Petitioner's arguments with respect to claims 18 and 19, beyond the arguments it presented with respect to independent claim 1 and independent claim 10. PO Resp. 50, 53; Ex. 2030 ¶ 106 (“The addition of MacLeod as a reference does not alter the non-obviousness of claims 1 or 10, and thus dependent claims 18-19.”).

Based on the foregoing, we determine that Petitioner demonstrates by a preponderance of the evidence that claims 18 and 19 would have been obvious over the combined disclosures of Giacino, Proulx, Conrad, and MacLeod.

4. *Remaining Grounds Based on Giacino*

Because the grounds based on Giacino, Proulx, and Conrad are dispositive as to all challenged claims, we need not reach the remaining grounds based on Giacino. *See SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1359 (2018) (holding that a petitioner “is entitled to a final written decision addressing all of the claims it has challenged”); *Bos. Sci. Scimed, Inc. v. Cook Grp. Inc.*, 809 F. App’x 984, 990 (Fed. Cir. 2020) (non-precedential) (recognizing that the “Board need not address issues that are not necessary to the resolution of the proceeding” and, thus, agreeing that the Board has “discretion to decline to decide additional instituted grounds once the petitioner has prevailed on all its challenged claims”).

IV. CONCLUSION

<b>Claim(s) Challenged</b>	<b>35 U.S.C. §</b>	<b>Reference(s)/Basis</b>	<b>Claim(s) Shown Unpatentable</b>	<b>Claim(s) Not Shown Unpatentable</b>
1–5, 7–9, 23, 24	102	Brown		1–5, 7–9, 23, 24
1–12, 14– 17, 20–24	103	Giacino, Brown <sup>11</sup>		
18, 19	103	Giacino, Brown, MacLeod <sup>12</sup>		
1, 2, 4–7, 9–12, 14, 15, 20–24	103	Giacino, Conrad, Crane		1, 2, 4–7, 9– 12, 14, 15, 20–24
3, 16	103	Giacino, Conrad, Crane, Proulx		3, 16

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<sup>11</sup> We do not reach this ground.

<sup>12</sup> We do not reach this ground.

<b>Claim(s) Challenged</b>	<b>35 U.S.C. §</b>	<b>Reference(s)/Basis</b>	<b>Claim(s) Shown Unpatentable</b>	<b>Claim(s) Not Shown Unpatentable</b>
8, 17	103	Giacino, Conrad, Crane, Perret		8, 17
18, 19	103	Giacino, Conrad, Crane, MacLeod		18, 19
1–7, 9–12, 14–16, 20– 24	103	Giacino, Proulx, Conrad	1–7, 9–12, 14–16, 20–24	
8, 17	103	Giacino, Proulx, Conrad, Perret	8, 17	
18, 19	103	Giacino, Proulx, Conrad, MacLeod	18, 19	
<b>Overall Outcome</b>			1–12, 14–24	

Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner’s attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

## V. ORDER

For the foregoing reasons, it is

ORDERED that claims 1–12 and 14–24 of the ’096 patent have been shown to be unpatentable;

FURTHER ORDERED that the Motion to Exclude Exhibits 1021, 1027, 1029–1032, 1034–1036, 1046–1047, 1049, 1056, 1060, 1064, 1073, 1082, 1084, 1087, 1095–1096, 1098–1101, 1107–1115, 1119–1120, 1123, 1133, 1135, 1137–1138, 1141, 1146–1147, 1149–1150, 1152, 1157–1159, 1180, and 1184 is dismissed as moot;

FURTHER ORDERED that the Motion to Exclude Exhibits 1047, 1050, 1057, 1059, 1064, 1067, 1070, 1074, 1085, 1089, 1106, 1118, 1183, 1185, and 1187 is denied; and

FURTHER ORDERED that because this is a Final Written Decision, parties to this proceeding seeking judicial review of the Decision must comply with the notice and service requirements 37 C.F.R. § 90.2.

IPR2023-00206  
Patent 9,943,096 B2

FOR PETITIONER:

Joseph M. Paunovich  
James Glass  
Sandra Haberny  
Razmig Messerian  
Quincy Lu  
QUINN EMANUEL URQUHART & SULLIVAN, LLP  
joepaunovich@quinnemanuel.com  
jimglass@quinnemanuel.com  
sandrahaberny@quinnemanuel.com  
razmesserian@quinnemanuel.com  
quincylu@quinnemanuel.com

FOR PATENT OWNER:

Michael Rosato  
Lorelei Westin  
Wendy Devine  
Matthew Reed  
Tasha Thomas  
WILSON SONSINI GOODRICH & ROSATI  
mrosato@wsgr.com  
lwestin@wsgr.com  
wdevine@wsgr.com  
mreed@wsgr.com  
tthomas@wsgr.com