

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MOTIF FOODWORKS, INC.,

Petitioner,

v.

IMPOSSIBLE FOODS INC.,
Patent Owner.

U.S. Patent No. 9,943,096

“METHODS AND COMPOSITIONS FOR
AFFECTING THE FLAVOR AND AROMA
PROFILE OF CONSUMABLES”

Inter Partes Review No. 2023-00206

**REBUTTAL DECLARATION OF DR. ROBERT MCGORRIN
IN SUPPORT OF PETITIONER’S REPLY TO PATENT OWNER’S
RESPONSE**

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I, Robert McGorrin, declare as follows:

1. I have been retained by Quinn Emanuel Urquhart & Sullivan LLP on behalf of Motif FoodWorks, Inc. (“Petitioner” or “Motif”) as an independent expert in this *inter partes* review (“IPR”) proceeding which is pending before the Patent Trial and Appeal Board (“the Board”) of the United States Patent and Trademark Office (the “Proceeding”). I understand that in this Proceeding Motif is challenging the validity of claims 1-12 and 14-24 of U.S. Patent No. 9,943,096 (the “Challenged Patents” and “Challenged Claims”).

2. On December 7, 2022, I provided a declaration in support of Petitioner’s IPR Petition (“Opening Declaration”). My Opening Declaration is Exhibit 1005 to the Petition and provides an explanation of my qualifications, a discussion of the science and industry relevant to the ’096 patent, and my opinions with respect to the ’096 patent. I understand that Patent Owner noticed me for deposition on my Opening Declaration, yet ultimately withdrew that notice and I was not deposed on those opinions.

3. I have prepared this declaration (“Rebuttal Declaration”) to address certain arguments made in the Patent Owner Response (“POR”) and the accompanying Declaration of Michael Qian in support of the Patent Owner Response (Ex. 2030, “Dr. Qian Declaration”).

4. In addition to the materials referenced and cited in my Opening Declaration, I have reviewed and considered the Board's Institution Decision, Patent Owner's Preliminary Response and its Response, and the declaration of Michael Qian, Ph.D. in support of Patent Owner's Response.

5. The opinions set forth in this Rebuttal Declaration are based on my personal knowledge, my professional judgment, and my analysis of the materials, information, and exhibits referenced in my opening declaration and Rebuttal Declaration.

I. LEGAL STANDARDS

6. I am not an attorney and have been informed of pertinent legal standards by Motif's counsel.

7. As set forth in my Opening Declaration (Ex. 1005, ¶24), I am informed and understand that one way obviousness may be established is by finding that all claimed limitations are disclosed in the prior art, and that a person of ordinary skill in the art would have been motivated to combine or modify the teachings in the prior art and would have had a reasonable expectation of success in doing so. I am further informed and understand that absolute predictability of success is not required, only a reasonable expectation.

8. I am further informed and understand that when the prior art does not expressly disclose a claim limitation, "inherency" may supply a missing claim

limitation in an obviousness analysis. I am further informed and understand that inherency is established in the context of obviousness when the limitation at issue necessarily must be present, or the natural result of the combination of elements explicitly disclosed by the prior art.

II. RESPONSES TO DR. QIAN'S DECLARATION AND PATENT OWNER RESPONSE CONCERNING GROUND 2

A. Dr. Qian's Opinions Regarding Whether Limitations 1[e]/10[f] Are Obvious Over the Combination of Giacino and Brown Are Incorrect

9. Dr. Qian offers certain opinions regarding whether the combination of Brown and Giacino renders obvious limitations 1[e] and 10[f] of the '096 patent. I disagree with Dr. Qian as explained below.

10. Dr. Qian states that "Petitioner asserts that '[a] POSITA would understand that heating Giacino's composition, which includes cysteine, thiamine, and ribose, induces a Maillard reaction that produces a myriad of volatiles (at least two) known to have a meat-associated aroma.'" Ex. 2030, ¶67 (citing Pet., 34 (in turn citing Ex. 1003, ¶210)). Dr. Qian states that "Petitioner's assertion is based on the assumption that 'Giacino's composition, which includes cysteine, thiamine, and ribose,' *inherently (or necessarily)* will produce a Maillard reaction when heated, even in the presence of the leghemoglobin of Brown, that would lead to the production of 'at least two volatile compounds which have a meat-associated aroma.'" *Id.* (emphasis added). Dr. Qian concludes that "Petitioner's assertion that

‘Giacino’s composition, which includes cysteine, thiamine, and ribose,’ without more specificity, is insufficient to show that a Maillard reaction will occur and, even if it did, that it would lead to the production of ‘at least two volatile compounds which have a meat-associated aroma.’” Ex. 2030, ¶68.

11. Dr. Qian is incorrect in several respects, as I explain in greater detail below. As an initial matter, I am informed and understand that Petitioner did not advance an “inherency” theory of obviousness in this proceeding. Thus, it is my understanding that, where Dr. Qian contends that Petitioner fails to show the claimed volatiles are “inherently (or necessarily)” produced—either in any particular reference alone or in any combination of references, Dr. Qian relies on a different legal standard of obviousness than Petitioner. I rely herein on my understanding of the legal principles of obviousness as set forth above and in my Opening Declaration.

1. Dr. Qian Incorrectly Characterizes Giacino’s Maillard Reaction Disclosure

12. As context for my opinions replying to Dr. Qian, I understand that Petitioner and Dr. Tarté rely on Giacino’s explicit disclosures that its compositions, which include cysteine, thiamine, and ribose among other ingredients, produce a “meat flavor” or “meaty flavor” after undergoing a “reaction” when heated. Pet., 33 (citing Giacino (Ex. 1015), 2:5-8, 6:15-17, 6:20-23); Ex. 1003, ¶¶208-209 (citing same). I understand that Dr. Tarté relied on my opinions in rendering his opinions on the obviousness of combining Giacino and Brown. *E.g.*, Ex. 1003, ¶¶209-210.

13. Dr. Tarté also relied on my testimony about how the terms “aroma” and “flavor” are used interchangeably in the art to correctly conclude that Giacino’s reference to “meat flavor” or “meaty flavor” also refers to meaty *aroma*. *Id.* (citing Ex. 1005, ¶27). Indeed, as excerpted below, Dr. Qian agrees that a POSITA would understand a reference to meaty “flavor” to mean meaty aroma.

[Q:] So to reiterate, I believe, what you said, flavor is a function of two things: aroma and taste. But at least professionally and in academia, flavor and aroma are used interchangeably, correct?

**

[A:] Yes, many times.

[Q:] Many times?

[A:] Many times. People, when they say “flavor,” they mean aroma, unless the presenter -- until specified.

Ex. 1182 (Qian Tr.), 40:3-41:22.

[Q:] When Giacino says “a meaty flavor is developed,” what does that mean to you?

[A:] My understanding would be some aroma generated which are associated with -- give a meaty attribute.

Ex. 1182 (Qian Tr.), 48:14-21.

14. Contrary to Dr. Qian’s positions above, a POSITA would understand from Giacino’s disclosure that its heat-reacted compositions produce meaty flavor and aroma and that heat-reacting Giacino’s compositions produces at least two or more volatiles which have a meat-associated aroma. *E.g.*, Ex. 1003, ¶¶208-211. As

shown in the exemplary excerpt below, Giacino teaches methods for achieving “meat flavor” in its compositions through a “reaction” at certain temperatures and cooking times.

15 The meat flavor of the compositions of the present
invention is developed by heating the pre-mix composi-
tions at an elevated temperature for a period of time. The
time and temperature are interrelated, longer times being
required at low temperatures for best flavor develop-
20 ment and shorter times for higher temperatures. It is
preferable to utilize temperatures of at least 200° F.
in order to accomplish the reaction in a reasonable
length of time. Generally, temperatures much above 420°
F. make the reaction difficult to control and may well
25 produce uncharacteristic burnt notes even with very short
reaction times. Accordingly, it is preferred to carry out
the reaction at temperatures of from about 200° F. to
about 420° F., until the desired flavor development is
achieved. The heating periods may range from about
30 one-quarter minute to about 6 hours depending upon the
heating method used.

Giacino (Ex. 1015), 6:15-31; *see also* Ex. 1003, ¶209, 244 (citing Giacino (Ex. 1015), 6:15-17, 20-23, 26-31).

15. Thus, Giacino expressly teaches that its compositions undergo a “reaction” when heated to produce a meaty flavor/aroma. Giacino (Ex. 1015), 1:19-25, 1:59-65, 2:5-8, 6:15-17, 6:20-23. As excerpted above, Giacino discloses cooking temperatures and times that would certainly support chemical reactions, including Maillard, that would generate meaty aromas. *Id.*, 6:15-71 (200° F to 420° F at a quarter of a minute to 6 hours), 7:40-8:36 (*e.g.*, 350-390° F for 10-15 minutes); *see also* MacLeod (Ex. 1024), 373 (explaining that Maillard reaction can occur at 90° C (*i.e.*, 194° F) and increases with temperature and time). As I previously explained,

the aroma of cooked meat, as taught in Giacino, implicates the presence of meat character-impact volatile chemical compounds, such as such as 2-methyl-3-furanthiol (MFT), bis(2-methyl-3-furyl) disulfide (MFT-MFT), 2-furfurylthiol, and 2-mercapto-3-pentanone, as well as hundreds of other volatiles identified in the literature. Ex. 1005, ¶¶33-41.

16. Further, relying on my Opening Declaration, Dr. Tarté correctly recognized that Giacino’s compositions contain well-known meat flavor precursors, including, for example, thiamine, cysteine, ribose, and vegetable protein hydrolysate, which Dr. Qian does not dispute. *E.g.*, Ex. 1003, ¶¶210-211. As I previously opined, these ingredients are well-known Maillard reaction precursors. *See* Ex. 1005, §V.B.

17. Contrary to Dr. Qian’s positions (*e.g.*, Ex. 2030 ¶71)¹, heat-reacting such meat flavor precursors under certain conditions, such as those described in

¹ Here, Dr. Qian opines that Petitioner has “not provided sufficient evidence to show that the Giacino composition (whatever that may be) when cooked necessarily ‘result[s] in the production of at least two volatile compounds which have a meat-associated aroma,’ nor that such necessarily produced volatile compounds would still be present after the addition of the leghemoglobin of Brown.”). I disagree with Dr. Qian as explained in greater detail throughout this Reply Declaration.

Giacino, has long been known to produce scores of volatiles associated with the aroma of cooked meat. *See* Ex. 1003, ¶¶210-211 (citing Ex. 1005, Sections V.B., V.D.). A POSITA's knowledge of these methods and the Maillard reaction itself, coupled with Giacino's explicit disclosure above that cooking its Maillard reactant-containing compositions produces a meaty aroma, supports the conclusion that, according to the methods taught in Giacino, heating Giacino's compositions produces at least two volatiles which have a meat-associated aroma. Ex. 1003, ¶210.

18. For example, according to the principles I explained in my Opening Declaration, and contrary to Dr. Qian's positions (*e.g.*, Ex. 2030 ¶71), a POSITA would recognize that Giacino's reaction conditions cause the cysteine and ribose present in those compositions to react with one another during the heating process to produce the volatile compounds the literature teaches would be produced when reacting cysteine and ribose. *See, e.g.*, MacLeod (Ex. 1024), 385 (Table 15 listing more than 40 volatile compounds produced when reacting cysteine and ribose), 312-356 (identifying many of the same volatile compounds as that of natural beef aroma including, for example, carbon disulfide, hydrogen sulfide, methanethiol, furfural, pyrrole, 2,5-dimethylpyrazine, 2-methylthiazole); *see also* Ex. 1005, ¶59 (explaining that temperatures above 150° C rapidly produce pyrazines, which are known volatile compounds of beef aroma and present when reacting cysteine and ribose).

19. Accordingly, contrary to Dr. Qian's positions (*e.g.*, Ex. 2030 ¶71), a POSITA would understand that the disclosure of meaty aroma in Giacino means that heating Giacino's compositions produces numerous volatiles which have a meat-associated aroma—and certainly two or more such compounds. *E.g.*, Ex. 1003, ¶¶210-211. For example, as I previously opined, a POSITA would reasonably expect cooking Giacino's composition to produce the meat character-impact volatile compounds MFT and MFT-MFT. Ex. 1005, ¶112.

20. Indeed, I understand that, in his deposition, Dr. Qian agreed that the meaty aromas taught in Giacino result from the presence of at least two volatiles having a meat-associated aroma. Ex. 1182 (Qian Tr.), 44:5-44:23 ([Q:]: "But it's fair to say that no matter the meat aroma we are talking about ..., certainly more than ten volatiles would be involved in contributing to that aroma, right?" [A:]: "Typically, it's the case."), 47:4-49:14 ([Q:]: "Is there anything about Giacino's teaching here that, when it says 'a meaty flavor is developed,' that leads you to believe that less than ten volatiles are being generated?" [A:]: "I do not believe so."); 48:1-13. Accordingly, I understand Dr. Qian agrees that, as taught in Giacino, heat-reacting Giacino's compositions produces at least two volatile compounds which have a meat-associated aroma.

21. Dr. Qian's discussion of how different environmental factors and conditions, including cooking temperature, cooking time, pH, water, salt, and lipids

can play a role in the Maillard reaction and other chemical reactions, does not affect the correctness of Dr. Tarté's opinions for several reasons. Ex. 2030, ¶¶35-40, 68.

22. *First*, contrary to Dr. Qian's positions (*e.g.*, Ex. 2030 ¶71), a POSITA would understand that the detailed disclosure of Giacino accounts for such conditions. *E.g.*, Giacino (Ex. 1015), 5:1-10, 6:15-71, 7:38-10:42. As excerpted above, for example, Giacino teaches specific precursors, cooking temperatures, and cooking times for its compositions. *See id.*, 6:15-23. Because Giacino teaches that its compositions produce a meaty aroma after undergoing a reaction when heated, a POSITA would understand that the reaction conditions taught in Giacino—*e.g.*, cooking temperature, cooking time, and matrix—permit the chemical reactions that produce volatiles which have a meat-associated aroma, including the Maillard reaction.

23. *Second*, as previously opined by myself and Dr. Tarté, a POSITA for the '096 patent would have a certain level of relevant skill and training, as well as access to the knowledge of flavor chemists, all of which would inform any understanding of or adjustments to the preparation of prior art compositions, such as Giacino or Giacino/Brown compositions. In contrast, Dr. Qian's analysis is incorrect as it does not account for a POSITA's level of skill.

24. For example, as I noted in my Opening Declaration, "I understand that Dr. Rodrigo Tarté has opined that a POSITA for the Challenged Patents [including

the '096 patent] would have a Bachelor of Science degree in food sciences, biology, chemistry, microbiology, or a related discipline. A POSITA would also 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.” Ex. 1005, ¶82. I agreed with Dr. Tarté's POSITA definition. *Id.*, ¶83. Relatedly, as I previously opined, a POSITA for the '096 patent would have been familiar with the relevant food science literature, principles, and techniques in the art, including the various factors/conditions governing the Maillard reaction and other reactions that produce meaty aromas and would know how to make adjustments to such factors like pH, cooking times/temperature, moisture, and so forth. Ex. 1005, ¶¶111-113; *see also id.*, ¶¶44-70. Accordingly, a POSITA would have certain training and access to the knowledge of flavor chemists, and would interpret the prior art with this understanding.

25. Additionally, as I previously opined, such conditions/factors, including but not limited to pH, compositional mix, precursor concentrations, cooking time, cooking temperature, and the moisture content, are variables that were known before 2013 to affect the production of volatiles from the Maillard reaction and other reactions that produce meaty aromas. Ex. 1005, ¶113 (citing Section V.B). Reaction conditions involved in creating different types of so-called process meat flavors were

well known prior to 2013. *See id.* V.B.1 (“Factors Affecting Maillard Chemistry”), citing Ex. 1034 (Reineccius, Chapter 9, 2006), pages 271-272; 263-274.

26. Because a POSITA would have familiarity with food science literature, principles and techniques, *see* Ex. 1005, Section IV.A, and contrary to Dr. Qian’s positions (*e.g.*, Ex. 2030 ¶71), only ordinary skill would have been needed to follow the teachings of the prior art and adjust these conditions/factors to produce a meaty aroma and volatile compounds associated with a meaty aroma. Ex. 1005, ¶113. Indeed, Giacino acknowledges that “[i]t is well within the skill of the art to utilize as much as or as little additional ingredients, foods and the like in the compositions of the invention in order to obtain varieties of flavor, additional notes and the like.” Ex. 1015, 9:30-34.

27. Indeed, Dr. Qian agrees that these Maillard reaction parameters were well-known and could be manipulated efficiently in light of the teachings of the prior art, such as Giacino. *See* Ex. 1182 (Qian Tr.), 33:22-34:2, 34:14-35:1; 38:15-24 ([Q:] “Do you think a person of ordinary skill in the art would be able to re-create any known, published flavor reaction meat-flavoring product?” [A:] “If -- if the publication give specific detail, like composition, ratio, temperature, time, yes, it will save a lot of time.”).

28. Similarly, Dr. Qian’s assertion that Giacino does not expressly disclose the Maillard reaction (Ex. 2030, ¶67) is incorrect for several reasons.

29. *First*, as explained above, Giacino teaches the production of meaty flavors and aromas following the heating of its compositions. Thus, contrary to Dr. Qian's positions, a POSITA would understand that, given Giacino's teaching of well-known Maillard flavor precursors in its compositions, its reference to a "reaction" (*e.g.*, Giacino (Ex. 1015), 6:22), its disclosure that a meaty aroma is generated upon heating, and its use of heating temperatures and times consistent with Maillard (*id.*, 6:15-71), Giacino does induce a Maillard reaction to produce the claimed aroma/volatiles. *E.g.*, Ex. 1003, ¶¶210-211.

30. *Second*, from my review of the '096 patent claims, they do not recite any specific chemical reaction to produce volatiles having a meat-associated aroma, and I am not aware that they have been interpreted to require any particular reaction. However, the claimed "compounds," including the precursors taught in Giacino, are familiar Maillard reactants as explained above and in my Opening Declaration. A POSITA would therefore recognize that Giacino's precursors can and do combine in the Maillard reaction, as explained above.

31. Dr. Qian also argues that Petitioner does not address the impact taurine has on Giacino's compositions and, thus, "Petitioner has not shown that the mere presence of cysteine, ribose, and thiamine" would "necessarily" produce at least two volatiles having a meat-associated aroma. Ex. 2030, ¶69. I disagree for several reasons.

32. *First*, Dr. Qian mischaracterizes the obviousness analysis. The relevant question is, as explained above, whether a POSITA would be motivated to combine Brown and Giacino to achieve the claimed subject matter of the '096 patent with a reasonable expectation of success. From my review of the '096 patent claims, they do not exclude taurine or require that the food flavor additive composition contain only the specific claimed compounds. As explained above, Giacino discloses the claimed compounds ribose, cysteine, and thiamine and Dr. Qian fails to show otherwise. Dr. Qian has failed to explain the relevance of taurine to his contrary legal opinions.

33. *Second*, relatedly, Dr. Qian fails to explain how the inclusion of taurine in Giacino's compositions changes the obviousness analysis with respect to the production of the claimed volatile compounds. As explained above, Giacino discloses that its compositions produce a meaty aroma upon cooking, implicating the production of at least two volatiles having a meat-associated aroma. Thus, Giacino teaches this limitation of the claims, which do not exclude the presence of taurine.

34. *Third*, contrary to Dr. Qian's positions (*e.g.*, Ex. 2030 ¶71), and regardless of the presence of taurine, a POSITA would understand the claimed Maillard precursors taught in Giacino (*e.g.*, ribose, cysteine, and thiamine) could combine under the conditions described in Giacino to produce the claimed volatile

compounds. As discussed in my Opening Declaration, MacLeod teaches that heat-reacting such combinations produce many volatiles. Ex. 1005, ¶¶68-69.

35. Similarly, Dr. Qian's assertion that the Maillard reaction is known to produce non-meat aromas, such as coffee and chocolate (Ex. 2030, ¶¶35, 68), is irrelevant to the present obviousness analysis because Giacino explicitly teaches that heating its compositions produces a *meaty* aroma.

2. Dr. Qian Is Incorrect that Adding Brown's Leghemoglobin Affects the Obviousness of Giacino's Maillard Reaction Disclosure

36. Dr. Qian asserts that Petitioner fails "to show that the Giacino composition (whatever that may be) when cooked necessarily 'result[s] in the production of at least two volatile compounds which have a meat-associated aroma,' nor that such necessarily produced volatile compounds would still be present after the addition of the leghemoglobin of Brown." Ex. 2030, ¶71. He identifies a number of potential ingredients that Giacino discloses may be included in its compositions, including vegetable protein hydrolysate, albumin, globulin, and gum Arabic and notes that Petitioner's Ground 2 adds Brown's leghemoglobin to Giacino's compositions. *Id.*, ¶70. Dr. Qian argues that "the inclusion of additional ingredients can affect whether or not certain aroma compounds will be produced," and that "the identity of the aroma compounds[] ... may contribute positively or adversely to flavor." *Id.* I disagree with Dr. Qian as explained below.

37. As an initial matter, based on Giacino's and Brown's teachings, Petitioner and Dr. Tarté argued that a POSITA would have been motivated to add Brown's leghemoglobin to Giacino's compositions and would have had a reasonable expectation of success in achieving the claimed invention (*e.g.*, a composition that, when cooked, would produce at least two volatiles having a meat-associated aroma). *E.g.*, Pet., 26-34; Ex. 1003, ¶¶170-196, 208-212.

38. Contrary to Dr. Qian's positions (*e.g.*, Ex. 2030, ¶71), both Giacino and Brown teach that preparing their meat-flavored compositions results in the production of volatiles which have a meat-associated aroma. Dr. Qian's assertions ignore these teachings.

39. Specifically, Brown discloses a meat substitute that "includes a heme-containing protein, *e.g.*, soy leghemoglobin, that 'contributes favorably to aroma of meat replicas.'" Ex. 1003, ¶80 (quoting Brown (Ex. 1012), [00364]). "Brown teaches a POSITA how heating a composition containing leghemoglobin and flavor precursors (*e.g.*, pea flour, oil, and glucose) produces volatile compounds having '*the aroma of cooked meat*' that are 'consistent[ly] differen[t]' than the volatiles produced by the same composition lacking leghemoglobin. Brown further describes how gas chromatography mass spectrometry (GC-MS) revealed that the composition containing leghemoglobin produced a number of volatile compounds, including 2-octanone, 2-methyl furan, and 'many other ... compounds,' that were 'found

exclusively or more abundantly’ in the leghemoglobin-containing composition versus the composition without leghemoglobin. Brown teaches that these compounds are relevant because they ‘are often associated with the aroma of cooked meat.’” *Id.*, ¶193 (quoting Brown (Ex. 1012), [00364]) (emphasis added).

40. Brown also teaches heat-reacting a well-known Maillard precursor, glucose, with pea flour in the presence of leghemoglobin. *E.g.*, Ex. 1003, ¶81. “Pea flour” is itself not a Maillard precursor. However, certain amino acids are the building blocks of proteins. A POSITA would thus expect pea protein to contain amino acids including cysteine and methionine. Accordingly, a POSITA would recognize that there are certain similarities between the Giacino and Brown compositions, including the presence of Maillard precursors (ribose and glucose, respectively) which are both reducing sugars.

41. Thus, although Brown’s compositions are not identical to the compositions taught in Giacino, both references disclose well-known, familiar Maillard precursors as part of the respective compositions that, when heated as described, produce volatile compounds which have a meat-associated aroma.

42. Brown’s teachings therefore undermine Dr. Qian’s assertions that a POSITA would not be motivated to add leghemoglobin to Giacino’s compositions, for example, due to the possibility of negatively affecting the aroma. In fact, as I explain above, Brown’s teachings would lead a POSITA to reasonably expect that

the proposed combination with Giacino would produce at least two volatile compounds having a meat-associated aroma.

43. Additionally, for multiple reasons, contrary to Dr. Qian's positions (*e.g.*, Ex. 2030, ¶71), it would be obvious to a POSITA to combine Brown's leghemoglobin with Giacino's compositions to produce volatiles which have a meat-associated aroma. *E.g.*, Ex. 1003, ¶¶209-212.

44. *First*, a POSITA for the '096 patent would have certain relevant skill and training, as well as access to the knowledge of flavor chemists, all of which would inform any adjustments to the preparation of Giacino compositions modified to contain Brown's leghemoglobin, to the extent necessary to do so. I describe a POSITA's understanding in greater detail above.

45. *Second*, Giacino and Brown each disclose detailed information concerning parameters such as the identities and concentrations of precursors/ingredients used, cooking times, and cooking temperatures that promote the creation of meaty aromas. *E.g.*, Giacino (Ex. 1015), 5:1-10, 6:15-71, 7:38-10:42; Brown (Ex. 1012), [0364], [0388]-[0412]. For example, Brown teaches cooking its compositions that include leghemoglobin at temperatures and times that would support reactions. Brown (Ex. 1012), [0364] (140° C (*i.e.*, 284° F) for 10 minutes), [0412] (350° F for 2 minutes). The same is true for Giacino. Giacino (Ex. 1015),

6:15-71. As noted, Dr. Qian agrees that these parameters were familiar and could be adjusted. *E.g.*, Ex. 1182 (Qian Tr.), 33:22-34:2, 34:14-35:1.

46. Contrary to Dr. Qian's positions (*e.g.*, Ex. 2030 ¶71), a POSITA would be motivated to follow the express teachings of Brown and Giacino, which—as explained in the references themselves—produce volatiles which have a meat-associated aroma. A POSITA would be able to adjust particular reaction conditions, if desired. I discuss Giacino's reaction conditions above. Brown similarly teaches cooking its compositions that include leghemoglobin at temperatures and times that would support such reactions. Brown, [0364] (140° C (*i.e.*, 284° F) for 10 minutes), [0412] (350° F for 2 minutes).

47. Dr. Qian opines, however, that the inclusion of leghemoglobin in Giacino's compositions can affect whether or not certain aroma compounds will be produced, which “could shift [the aroma] from desirable to undesirable.” Ex. 2030, ¶70. I disagree. Dr. Qian mischaracterizes the obviousness analysis, as the '096 patent claims do not recite a “desirable” aroma and claims 1-9 and 24 do not recite any specific aroma.

48. I disagree with Dr. Qian because a POSITA would recognize that Giacino teaches the production of volatiles which have a meat-associated aroma by heat-reacting Maillard precursors, as explained above. This would be obvious to a POSITA even if other ingredients in the composition, including leghemoglobin,

reacted to produce additional volatile compounds or changed the overall aroma of the composition.

49. Indeed, I note that, when asked about combining Maillard precursors under different conditions, Dr. Qian agreed that, even changing reaction parameters change would lead to production of at least some of the same volatile compounds across different aromas. *See* Ex. 1182 (Qian Tr.) 55:14-58:13; *id.* 57:25-58:5 ([Q.] “[W]ould you expect at least some compounds to be the same, even if the [precursor] concentrations are different and the end aroma is different?” [A.] “Yes.”).

50. To the extent leghemoglobin interferes with the reaction(s) taught in Giacino, contrary to Dr. Qian’s positions (*e.g.*, Ex. 2030 ¶71), a POSITA would be able to adjust its concentration in a composition using only ordinary skill (*e.g.*, Ex. 1003, §XII). However, a POSITA would reasonably expect success combining Giacino’s compositions with Brown at least because Brown explicitly teaches that combining leghemoglobin “contributes favorably to aroma of meat replicas” in similar compositions. Ex. 1003, ¶80 (quoting Brown (Ex. 1012), [00364]).

51. Moreover, as explained above, contrary to Dr. Qian’s positions (*e.g.*, Ex. 2030 ¶71), only ordinary skill would be required to adjust Giacino’s reaction conditions and its compositions’ ingredients and their quantities, to the extent desired. According to the principles set out in my Opening Declaration, a POSITA would have known how to adjust and account for the various well-known

environmental factors that affect the production of volatiles from the Maillard reaction. *E.g.*, Ex. 1005, ¶113; *see also id.* Section V.B. Thus, only ordinary skill would have been needed to adjust the various reaction conditions Dr. Qian identifies (Ex. 2030, ¶¶35-40) when heating Giacino's modified compositions, to the extent necessary in light of Giacino's explicit preparation instructions.

52. Dr. Qian's positions regarding the hypothetical possibility of undesirable aromas thus do not undercut the fact that it would be obvious to combine Brown and Giacino to produce volatiles which have a meat-associated aroma (*e.g.*, Ex. 1003, ¶¶208-213) and, in particular, that a POSITA would have had a reasonable expectation of success in adjusting these various well-known parameters to the extent necessary when preparing Giacino's compositions, modified to include Brown's leghemoglobin, to produce at least two volatile compounds which have a meat-associated aroma.

53. Accordingly, Dr. Qian fails to rebut the obviousness of combining Brown and Giacino.

B. Dr. Qian's Opinions Regarding Motivation to Combine Giacino and Brown Are Incorrect

54. As explained below, Patent Owner and Dr. Qian dispute that a POSITA would have been motivated to combine Giacino's and Brown's teachings for several reasons. As I explain below, these positions are incorrect.

1. Patent Owner Mischaracterizes My Testimony Concerning “Plant Proteins”

55. I understand that Patent Owner argues that “Dr. McGorin’s IPR testimony explains that ‘the combination of Maillard reactants and heme-containing protein with plant proteins and other components’ can lead to non-meat-like volatile profiles.” Reply, 32 (citing Ex. 1005, ¶164).

56. My previous statements do not change my opinions here as it related to the disclosure in Patent Owner’s own patents, not how a POSITA would view the prior art or how that understanding would relate to the obviousness of any claimed subject matter.

57. Moreover, Brown’s composition includes non-heme plant proteins. Brown, [0364] (pea proteins in pea flour), [0396]-[0412] (beef patties containing dark/white muscle replica that contains moong bean protein). Brown expressly teaches a POSITA that adding leghemoglobin to such non-heme protein containing compositions contributes favorably to the composition’s meaty aroma and produces volatiles having a cooked meat aroma exclusively or more abundantly than compositions without leghemoglobin. Brown, [0364]; *see also id.*, [0412]. Thus, contrary to Patent Owner’s contentions, a POSITA would understand based on Brown’s teachings that adding leghemoglobin to a composition containing non-heme plant proteins would not lead to off-flavors.

58. Patent Owner further contends that “in district court, Dr. McGorin opined that plant proteins generally were known to contribute to undesirable flavors and aromas, and Dr. Tarté explained that leghemoglobin is a protein produced by plants.” Reply, 32-33 (citing Ex. 2020, ¶69; Ex. 2032, 24:20-25:4).

59. I stated in my claim construction declaration before the District Court of Delaware that Patent Owner’s patents describe how *non-heme* plant proteins/compounds can lead to “planty” aromas. Ex. 2020, ¶69 (citing *e.g.*, Ex. 1157, 13:52-56 (lipoxygenase in legumes)). Notably, I did not state that Patent Owner’s patents disclosed that *heme* proteins, such as leghemoglobin, lead to “planty” aromas. *Id.* Thus, contrary to Patent Owner’s assertion, I did not argue that leghemoglobin leads to “planty” aromas. Moreover, Brown discloses that leghemoglobin contributes favorably and provides volatiles associated with cooked meat aromas. Brown (Ex. 1012), [00364].

2. Dr. Qian Has Not Shown that Giacino’s Modified Compositions Are Subject to Lipid Oxidation

60. Dr. Qian offers various opinions concerning lipid oxidation. As explained below, each is incorrect and inapplicable to the obviousness of combining Brown’s leghemoglobin with Giacino’s Maillard-containing compositions.

61. Dr. Qian argues that “Petitioner’s assertion does not consider at the time of filing [the ’096 patent], a POSA would not have expected that the addition of a heme-containing protein, specifically leghemoglobin, to the composition of Giacino

would ‘only further contribute to the meaty aroma’ because it fails to consider the known potential for the development of off-flavors induced by heme.” Ex. 2030, ¶75. These off-flavors, according to Dr. Qian, relate to lipid oxidation and autooxidation. Ex. 2030, ¶¶78-80. Dr. Qian is incorrect as explained below.

62. *First*, Dr. Qian mischaracterizes Petitioner’s argument and is factually incorrect as Dr. Tarté and I both previously opined on the potential for development of heme-induced off-flavors. Ex. 1003, ¶¶177-182 (discussing my Opening Declaration).

63. *Second*, certain exemplary compositions taught in Giacino do not include lipids and, from my review of Giacino, it does not require the inclusion of lipids in its flavorings. Indeed, I understand Dr. Qian agrees with me that ingredients present in Giacino’s modified composition may not be lipids. Ex. 1182 (Qian Tr.), 87:19-92:5.

Q. So is it fair to say that Giacino contemplates some compositions that don't have lipids in them?

A. Possible. You can make that assumption.

Q. I mean, it's not an assumption; it's what -- what Giacino states, right?

A. Okay.

Ex. 1182 (Qian Tr.), 91:7-14.

64. Moreover, Giacino teaches that water may be used as a preferred vehicle for its compositions, rather than a lipid (e.g., fat or oil).

It has been found, in preparing the reaction products of this invention, that the ingredients are desirably heated in a vehicle such as water, a triglyceride fat, natural fat, vegetable fat or the like. A triglyceride fat is preferred in the case of pork or poultry flavor compositions whereas water is preferred for beef formulations. The vehicle may constitute as much as 95 percent by weight or more and as little as 10 percent by weight or less of the total weight of the pre-mix to be reacted. Suitable results are obtained, however, at levels ranging from 50 to 90%. Tri-

Giacino (Ex. 1015), 5:22-27.

65. Furthermore, Brown's leghemoglobin is a protein, not a lipid. Thus, combination with Brown's leghemoglobin therefore does not add a lipid to Giacino's compositions.

66. Accordingly, the combination of Giacino and Brown does not necessarily include a lipid and Dr. Qian fails to show otherwise.

67. *Third*, as a matter of common sense, lipid oxidation cannot occur without the presence of a lipid. Dr. Qian agrees with me on this point.

Q. And if the lipids are not present, then it's -- lipid oxidation is not a concern?

A. If lipids is not exist, lipids oxidation is not a concern. ...

Ex. 1182 (Qian Tr.) 97:8-11.

68. Thus, a POSITA would understand that a composition that lacks lipids would not be at risk of lipid oxidation or autooxidation. Dr. Qian's opinion that Giacino's food flavor additive composition may develop off-flavors sitting on a shelf

(Ex. 2030, ¶80) is therefore unfounded at least because lipid oxidation is not at issue for Giacino's lipid-free compositions.

69. *Fourth*, as I previously explained in detail in my Opening Declaration, lipid oxidation can contribute positively to meat flavor. Ex. 1005, ¶¶130-136; Ex. 1182 (Qian Tr.), 82:20-83:4. Relatedly, a POSITA would be aware that Brown teaches that adding leghemoglobin to compositions containing oil contributes favorably to cooked meat aromas. Brown (Ex. 1012), [0364] (sunflower oil), [0412] (canola oil).

70. Dr. Qian relies on two items in the prosecution history of the '306 patent: (1) a paper allegedly recognizing the potential for a negative effect of heme protein on the organoleptic quality of maize (corn) products ("Proulx Thesis," Ex. 2003); and (2) a declaration by Dr. Cadwallader. Ex. 2030, ¶75 (citing Cadwallader Declaration (Ex. 2030), ¶¶76-77 (citing Ex. 1148, 2715-16)). Dr. Qian also contends that Petitioner's evidence of record supports his positions regarding off-flavors and lipid oxidation. *See* Ex. 2030, ¶77 (citing Ex. 1028, 70; Ex. 1048, Abstract). Dr. Qian's characterization of the evidence of record is incorrect at least because, as I explained in more detail in my Opening Declaration, such references fail to consider that off-flavors, if any, would develop *over time after cooking*. Ex. 1005, ¶¶133, 137.

3. Dr. Qian's Analysis Incorrectly Relies On Unclaimed Factors

71. Certain of Dr. Qian's opinions regarding lipid oxidation and/or off-flavors relate to practical or commercial considerations, such as shelf life, which are not recited in the '096 patent claims. I disagree as explained below.

72. For example, Dr. Qian disagrees with the assertion "that 'although heme-containing proteins can lead to lipid oxidation over time, a POSITA would understand that the food product is likely to be consumed shortly after cooking, before any undesirable lipid oxidation has had a chance to develop,'" on the basis that "the assertion fails to account for the combination proposed. Giacino teaches that its *compositions are heated to produce a meaty flavor and the compositions may be later added to a food product* as a food flavor additive." Ex. 2030, ¶80 (citing Giacino, 1:60-72, 6:15-31 (emphasis added)).

73. I disagree as Dr. Qian mischaracterizes the explicit disclosures of Giacino. Giacino teaches the addition of its flavorings to foodstuffs *without* cooking the flavorings beforehand:

The appropriate time of heating can readily be determined by observation of the flavor produced. The reaction is sufficiently easy to control that the proper extent of heating can readily be determined simply by heating the reaction mixture for a sufficient period to produce the desired poultry flavor. Generally, it is preferred to utilize heating times on the order of from about one-quarter minute to about three hours. Shorter times on the order of from about one-quarter to about three minutes at 250°–400° F. are preferably used in high heat transfer-rate heat exchangers. Where the flavor composition of this invention is added to a food which is to be subsequently heated or cooked, the reaction time can be reduced, and in some of these cases, heating the pre-mix independently of the food can even be eliminated.

Giacino (Ex. 1012), 6:71-75. As shown above, Giacino describes “*eliminat[ing]*” the step of “heating the pre-mix independently of the food.” *Id.* A POSITA would understand from this teaching that Giacino’s additives will be uncooked until they are cooked with the food itself, which a POSITA would understand may be followed by consumption before off-flavors have a chance to develop.

74. Following this teaching in Giacino, contrary to Dr. Qian’s positions above, a POSITA would understand that the risk of off-flavor development is mitigated because, prior to cooking, Giacino’s leghemoglobin-modified additives are not heat-denatured. Off-flavors (such as “warmed over” flavors or “WOF”) may arise from the heat-denaturation of heme proteins which releases iron ions, as I explained in my Opening Declaration. Ex. 1005, ¶¶129, 137.

75. Relatedly, Dr. Qian states that “Petitioner did not consider that food flavor additives are expected to have a reasonable amount of shelf life so that the

additives can be added to a food product. If a food flavor additive does not have a sufficient shelf life (because WOF has developed), the additive would be of limited commercial value as it would need to be utilized in a food product immediately after production.” Ex. 2030, ¶80.

76. I disagree. As explained above, Giacino’s compositions may be lipid-free and thus not be subject to lipid oxidation. Dr. Qian also fails to account for the availability of familiar preservatives that can prolong shelf life. Ex. 1005, ¶138.

77. Additionally, Dr. Qian misapplies the relevant obviousness analysis. From my review of the ’096 patent claims, they neither recite “shelf life” or “commercial value” of the claimed food flavor additive composition. Nor, from my review of **claims 1-9 and 23-24**, do they recite any particular time between heating the claimed food flavor additive composition and its consumption. Thus, consistent with the disclosures of Giacino, a POSITA would recognize that Giacino’s unheated flavoring composition could be added to the foodstuff before cooking, followed by prompt consumption before the development of off-flavors.

78. Dr. Qian also states that “Petitioner’s arguments also ignore that autoxidation can occur in food products without heat during storage, and such autoxidation can form undesirable aromas and flavors before consumption.” Ex. 2030, ¶79. I disagree at least because Giacino’s leghemoglobin-modified

compositions do not necessarily contain lipids as explained above, and therefore would not undergo lipid oxidation.

79. Moreover, as noted above, the '096 patent claims do not recite specific “storage” considerations. Thus, Dr. Qian’s position(s) are unconnected with the relevant obviousness analysis discussed herein.

80. Lastly, Dr. Qian states that “Petitioner’s assertion equates, without support, lipid oxidation within an actual meat product to lipid oxidation within a food flavor additive composition, when such products are completely different in terms of ingredients and matrix.” Ex. 2030, ¶79. Dr. Qian is again incorrect at least because, as noted above, Giacino’s compositions may not contain lipids. Therefore, lipid oxidation will not proceed in such compositions.

4. Dr. Qian’s Other Opinions Concerning Motivation to Combine Giacino and Brown Are Incorrect

81. Dr. Qian offers various opinions concerning the components in the compositions of Giacino and Brown, which he contends weighs against a POSITA’s motivation to combine these references. I disagree as explained below.

82. Dr. Qian Incorrectly Characterizes the Brown and Giacino Compositions. Dr. Qian contends that “*the compositions of Brown and Giacino are completely different* and Petitioner has failed to establish that a POSA would have expected that leghemoglobin would provide the same effect in the composition of Giacino.” Ex. 2030, ¶74 (emphasis added). Dr. Qian states that “[t]herefore,

Petitioner has not explained why a POSA working on a food flavor additive would have combined a meat replica with the concentrated flavoring composition of Giacino.” *Id.* Relatedly, Dr. Qian states that “Petitioner asserts that a POSA would understand that the modification of Giacino with the leghemoglobin of Brown ‘would only further contribute to the meaty aroma’” in Giacino and further states that this “assertion is not supported because the only basis stated is *Brown, which is a different composition from Giacino.* Just because leghemoglobin contributed to flavor in the composition of Brown does not mean that it would contribute in the same manner to the composition of Giacino.” Ex. 2030, ¶75 (emphasis added).

83. I disagree with Dr. Qian’s characterizations of the compositions of Brown and Giacino. As I explain in greater detail above, Giacino’s compositions are not identical to Brown’s compositions, but a POSITA would recognize that they are similar in certain respects (*e.g.*, as they contain reducing sugars and produce certain volatiles upon heating). Thus, the compositions of Brown and Giacino would not be “completely different” to a POSITA.

84. Relatedly, Dr. Qian does not acknowledge that Brown and Giacino’s foodstuffs share other similarities. For example, consistent with Dr. Tarté’s opinions, Giacino teaches that its flavorings can be combined with foodstuffs, such as “synthetic meat fibres.” It states:

The flavor compositions of this invention can be used to flavor various foods, liquid or dry. They are conveniently employed at levels of for example, from 0.05 to 15 weight percent. For example, they can be incorporated into gravies, sauces, soups, dressings, salads, aspics, purees and other liquid preparations at levels of from 0.05 to 2 and preferably from 0.1 to 1 weight percent. On the other hand, they can be admixed with carrier materials or with other flavoring ingredients or foodstuffs for incorporation into finished products, illustrative of which are the dry foods such as snacks, chips, synthetic meat fibres and the like. The compositions are conveniently employed at levels of 2 to 15 weight percent or more and preferably 5 to 10 weight percent in such applications.

Giacino (Ex. 1015), 7:15-26; *see also* Ex. 1003, ¶187 (recognizing “Giacino explains that these compositions “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.””) (quoting Giacino (Ex. 1015), 1:65-68, 7:15-26). Giacino therefore teaches the combination of its flavor additives with finished dry food products, including “synthetic meat” products like meat replicas as taught or suggested in Brown.

85. Thus, in combination with Giacino’s disclosure of eliminating the step of pre-cooking the flavor additive, Giacino teaches that its compositions can be added to foods (*e.g.*, “synthetic meat fibres”) and then heated to undergo a reaction that produces a meaty aroma. *See* Giacino (Ex. 1015), 6:71-7:2, 7:22-26. In combination with such foods, the Giacino flavoring is no longer concentrated. Accordingly, a POSITA would understand that Giacino teaches that its compositions can undergo heat reactions to produce meaty flavor/aroma in an *unconcentrated* matrix such as “synthetic meat fibres.” A POSITA would recognize similarities in

this approach with the combination of ingredients, such as glucose, plant proteins (pea flour), and leghemoglobin, in Brown's muscle replica. *E.g.*, Brown (Ex. 1015), [0364].

86. Dr. Qian attempts to distinguish Giacino and Brown based on his characterization of certain ingredients and their significance in the respective compositions. For example, he states that "Giacino instead teaches that its meaty flavor is based on taurine and thiamine. On the other hand, Brown discusses that its meaty aroma is based on the contribution of leghemoglobin." Ex. 2030, ¶73 (citing Ex. 1012, [00364]).

87. Dr. Qian again mischaracterizes the disclosures of both Giacino and Brown. Although it is true that Giacino's compositions contain taurine and thiamine, this teaching does not detract from the obviousness of combining Brown and Giacino for reasons I discuss above. Moreover, as explained above, Giacino teaches that meaty aroma is produced by heating its compositions, which contain various ingredients besides taurine and thiamine. Dr. Qian's characterization of Giacino's teachings incorrectly disregards or minimizes the contribution of those Maillard reactants.

88. For example, as excerpted below, Giacino teaches the significance of reducing sugars (*e.g.*, ribose) as well as other free amino acids (*e.g.*, cysteine) to create desirable flavoring compositions, and specific methods for successfully

incorporating such ingredients in its compositions. All of these compounds are well-known Maillard reactants. Indeed, Giacino motivates a POSITA to incorporate reducing sugars in its compositions because “[t]he presence of the saccharides results in a reacted composition having somewhat *more intense flavor characteristics*.” Giacino (Ex. 1015), 6:5-7 (emphasis added). Dr. Qian mischaracterizes Giacino by minimizing the significance of these and similar disclosures in Giacino.

tion, there may be added to the pre-mix a quantity of a saccharide material such as a mono saccharide or a polysaccharide exemplified by di- and trisaccharides. Ribose, sucrose, dextrose and xylose are illustrative of those which may be employed. The presence of the saccharides results in a reacted composition having somewhat more intense flavor characteristics. Care should be exercised in utilizing these materials, however, since they may tend to contribute some burnt notes to the final reacted product. When used, suitable results are obtained at levels ranging up to about 25 percent by weight based on the total weight of a vehicle-containing pre-reacted system. Preferably, the range is from 0.5–5 weight percent.

Giacino (Ex. 1015), 6:1-14.

89. Furthermore, contrary to Dr. Qian’s position above, Brown does not teach that its meaty aroma is exclusively due to the presence of leghemoglobin. Rather, Brown teaches that leghemoglobin “contributes” to meaty flavor. In particular, Brown teaches the presence of the familiar Maillard reactant glucose, which a POSITA would understand could also contribute to meaty aroma.

90. Dr. Qian's Opinions Incorrectly Require the "Same" Reaction Chemistry in Brown and Giacino. Relatedly, Dr. Qian advances various opinions concerning reaction chemistry that relate to Giacino and Brown's compositions. I disagree and address these positions in turn as explained below.

91. Specifically, Dr. Qian contends that "the compositions of Brown and Giacino are completely different and Petitioner has failed to establish that a POSA would have expected *that leghemoglobin would provide the same effect in the composition of Giacino.*" Ex. 2030, ¶74 (emphasis added). Relatedly, Dr. Qian states that "Petitioner asserts that a POSA would understand that the modification of Giacino with the leghemoglobin of Brown 'would only further contribute to the meaty aroma' in Giacino," and argues that "Petitioner's assertion is not supported because the only basis stated is Brown, which is a different composition from Giacino. Just because leghemoglobin contributed to flavor in the composition of Brown does not mean that *it would contribute in the same manner* to the composition of Giacino." Ex. 2030, ¶75 (emphasis added). Relatedly, Dr. Qian states that "Petitioner fails to establish what alleged 'catalyzation' reaction occurs in Brown

that *presumably would also occur* in Giacino.” Ex. 2030, ¶73 (citing Tarté deposition, 23:3-24) (emphasis added).²

92. Dr. Qian mischaracterizes Petitioner’s argument and a POSITA’s understanding of Brown and Giacino. As explained above, a POSITA would recognize similarities in the disclosures of Brown and Giacino (*e.g.*, the presence of Maillard precursors that, upon heating, result in certain volatiles). Petitioner is not contending that Giacino and Brown disclose *identical reaction chemistry*. Rather, Petitioner asserts that a POSITA would be motivated to combine Giacino’s compositions with Brown’s leghemoglobin in order to improve or enhance meaty aroma. *E.g.*, Ex. 1003, ¶95 (second bullet) (“A POSITA would have been motivated to add leghemoglobin to Giacino’s meaty flavoring compositions to better mimic the true flavor of meat.”).

93. Regardless, as discussed herein, a POSITA would recognize potential similarities in the reaction chemistry taught in Giacino and Brown, as both

² I note that Dr. Qian cites exclusively to Dr. Tarté’s deposition, not my Opening Declaration, and I note again that Patent Owner withdrew my own deposition notice in this proceeding. Accordingly, Dr. Qian’s position is premised on selective consideration of the available evidence.

references implicate Maillard chemistry to some extent. I discuss Giacino's Maillard chemistry in greater detail above (Section II.A.1).

94. Brown does not explicitly teach the reaction chemistry that underlies the disclosed benefits of adding leghemoglobin to its compositions. However, Brown explicitly teaches the significance of iron-containing heme, highlighting the potential importance of that chemical structure in creating "enhanced" meaty aromas. As Dr. Tarté stated, "Brown also explains that '[s]ome reactions that generate odorants released during cooking of meat can be catalyzed by iron, in particular the heme iron of myoglobin'" and "Brown states that 'some of the characteristic flavor and fragrance components are produced during the cooking process by chemical reactions catalyzed by heme.'" Ex. 1003, ¶83 (quoting Brown (Ex. 1012), [00363]); *see also id.* ¶173.

95. Indeed, Dr. Qian acknowledges that iron, such as iron in heme proteins, can catalyze chemical reactions. Ex. 1182 (Qian Tr.) 96:5-97:7 (discussing lipid oxidation chemistry). In fact, iron was known to catalyze the Maillard reaction. Ex. 1184 (Kato). Thus, contrary to Dr. Qian's apparent position that reaction chemistry would discourage a POSITA from combining Brown and Giacino, a POSITA would be aware from the explicit teachings of Brown itself that heme iron from leghemoglobin could catalyze Giacino's Maillard reaction-driven production of certain desirable volatiles.

96. Relatedly, Dr. Qian states that “neither Giacino nor Brown discuss that a Maillard reaction is the reactive component underlying the production of meaty flavor or aroma in its compositions.” Ex. 2030, ¶73. I disagree. Again, Dr. Qian mischaracterizes a POSITA’s understanding of Brown and Giacino. As I explained in detail in my Opening Declaration, Maillard chemistry has been well-known for nearly a century to produce meaty aromas. Ex. 1005, Section V.B. A POSITA would therefore recognize Giacino’s ribose, cysteine, and thiamine, and Brown’s glucose, as familiar Maillard precursors without those compounds needing to be identified explicitly as such.

97. Dr. Qian also states that “Petitioner does not explain why a POSA would be motivated to combine Giacino, which relies on one type of reaction, with the leghemoglobin-based contribution of Brown.” Ex. 2030, ¶73. Dr. Qian again mischaracterizes the disclosure of Giacino, as Giacino does not teach that it “relies on one type of reaction.” Rather, as explained above, Giacino teaches that its compositions include familiar, well-known Maillard reaction precursors, which are heated at certain temperatures and for certain times consistent with well-known Maillard chemistry, to produce meaty aromas. Giacino (Ex. 1012), 5:1-6:71, 7:40-10:42. A POSITA would therefore understand that Giacino discloses the Maillard reaction.

98. Giacino does not exclude the possibility that other chemical reactions will proceed when its compositions are heated, however. Indeed, consistent with Dr. Qian’s testimony, a POSITA would understand that different reactions producing meaty aromas, such as Strecker and Maillard, can occur at the same time in the same composition when heated. Ex. 1182 (Qian Tr.), 49:8-51:23; 54:22-55:5 ([Q.] “And while these two reactions are taking place while you are heating a meat-flavored composition, could they both be contributing to meaty aroma?” [A:] “Both reaction, they could contribute to a meaty flavor if the condition is correct.”).

99. Accordingly, Dr. Qian fails to show that a POSITA would not be motivated to combine Giacino and Brown in the manner Petitioner contends. Moreover, as I explain in Section II.A.2 above, from this combination, a POSITA would have a reasonable expectation of success in achieving the ’096 patent’s claimed subject matter.

III. RESPONSES TO DR. QIAN’S AND PATENT OWNER’S ARGUMENTS CONCERNING GROUND 4

A. Dr. Qian Incorrectly Contends Flavor Additives Would Not Have Nutritive Benefits

100. Dr. Qian argues that “the evidence of record indicates that flavor additives are meant to impart flavor, rather than nutrition.” Ex. 2030, ¶101, (citing Ex. 1038 (Manley), 139-140). I disagree with Dr. Qian’s characterization of the evidence of record.

101. As an initial matter, Manley (Ex. 1038) does not support Dr. Qian's position that flavor additives exclusively contribute flavor and may not impart other beneficial properties to a foodstuff. The portion of Manley quoted by Dr. Qian merely states that the "definition of a flavor captures the notion that it is a powerful material whose *significant* function is flavor and not nutrition or functionality." Ex. 2030, ¶101 (quoting Ex. 1038, 139-140 (emphasis added)). Dr. Qian does not rely on any teachings in Manley that the *only* function of a food flavor additive is to provide flavor. Rather, Manley's teaching is merely consistent with the proposition that a flavor does not need be nutritive or otherwise functional. Accordingly, a POSITA would not understand the single sentence in Manley quoted by Dr. Qian to teach that food flavor additive compositions do not or cannot provide nutritive benefits in addition to flavor.

102. In fact, Manley teaches the opposite. In discussing regulatory issues for meat and dairy process flavorings, Manley states that ingredients in process flavorings that "make a significant *nutritional* contribution to the final food" need to be disclosed to the Proprietary Mix Committee (PMC) when seeking approval of the flavoring. Ex. 1038 (Manley), 149-150 (emphasis added). Thus, Manley acknowledges that meat process flavorings can contain ingredients that provide nutritive benefits.

103. Dr. Qian does not address other evidence of record on this point. In particular, he does not address leghemoglobin’s dual benefits of flavor and nutrition, which are discussed by Dr. Tarté and taught in the prior art references Brown and Proulx, respectively. *E.g.*, Ex. 1003, ¶¶46-47, 71 (discussing Proulx’s teaching of leghemoglobin as a “fortificant”). Indeed, when Patent Owner submitted a GRAS notice to the FDA regarding its leghemoglobin-based additive, Patent Owner cited Proulx as evidence that this composition also provided “*nutritive value* as a source of iron” with high levels of bioavailability. Ex. 1052, 7 (emphasis added). Similarly, a POSITA would understand from Brown and Proulx that leghemoglobin could contribute multiple benefits to a flavor additive.

104. In addition, a POSITA would know that many common food flavor additive compositions are utilized at least in part for their nutritive benefits. As I discuss below, a few familiar examples of these compositions include nutritional yeast, garlic, salt, and MSG.

105. Nutritional yeast is a deactivated yeast product that is commonly sold as a powder or flakes. It is typically added to foods, such as cheese substitutes, condiments, and many other foods, for its nutritive benefits—it is rich in protein and B vitamins—as well as its distinctly umami flavor. *See, e.g.*, Ex. 1183 (Tomé), 487-490. I note that Dr. Qian agrees with me that nutritional yeast can be a food flavor additive with nutritive benefits. *See* Ex. 1182 (Qian Tr.), 105:7-106:18 ([Q:] “And

so to the extent that nutritional yeast is used as a popcorn seasoning, you would agree that, in that context, it's a food flavor additive composition?" [A:] "Yes, I would say normally I would consider, unless you added ridiculous amount to the popcorn."); 107:13-21 ("So you would agree with me that if what this article is saying is true, if, in fact, nutritional yeast has B-complex vitamins, that in addition to serving as a food flavor additive, it's also providing a nutritive benefit?" [A:] "Yes.").

106. Salt may be the most well-known food flavor additive that also provides nutrition. Salt contains sodium, which is an essential nutrient needed by the human body to maintain a balance of body fluids and muscle/nerve function. Ex. 1185 (FDA.gov), 4. Salt's use as a flavoring agent is ubiquitous.

107. As Dr. Qian agrees, garlic is also commonly used to flavor foods. Ex. 1182 (Qian Tr.), 100:9-101:19 (Dr. Qian agreeing that garlic is a food flavor additive when added to foods to impart a garlic flavor). As a POSITA would recognize, garlic provides many nutritive and health benefits. For example, studies have shown that garlic provides anticarcinogenic and antioxidative benefits. Ex. 1186 (Jun), 330, 332-33.

108. Monosodium glutamate (MSG) is a sodium salt of glutamic acid and is yet another food flavoring additive composition that is added to foods to provide flavor. Again, Dr. Qian agrees with me. Ex. 1182 (Qian Deposition), 100:2-100:8 (admitting that MSG is a food flavor additive composition as that term is used in the

'096 patent). MSG can be added to foods as a substitute for salt to provide a health benefit by reducing the amount of sodium present in the food for individuals watching their sodium intake, while maintaining the flavor acceptability of such foods. Ex. 1187 (Maluly).

109. Accordingly, the foregoing examples demonstrate that, contrary to Patent Owner's and Dr. Qian's position, food flavor additive compositions can be used to provide benefits besides merely flavor, including nutrition. Accordingly, Patent Owner's contention that food flavor additive compositions would not be modified to provide nutritive benefits is incorrect.

B. Dr. Qian's Positions Regarding Lipid Oxidation Are Incorrect

110. For Ground 4, as for Ground 2, Patent Owner questions whether Proulx's leghemoglobin "would result in a flavor composition having acceptable organoleptic properties" due to lipid oxidation concerns. POR, 51 (citing Ex. 2030, ¶¶38-40, 75-80).

111. I disagree. For reasons I explain in greater detail above (Section II.B.2), the possibility of lipid oxidation would not discourage a POSITA from combining Giacino's compositions—which do not contain lipids—with Proulx's leghemoglobin, a protein.

IV. CONCLUSION

112. In signing this Declaration, I recognize that the Declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

113. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on the information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed: January 5, 2024



Dr. Robert McGorin