Dispositions in the Kitchen: Towards a Metaphysical Model for Molecular Gastronomy

Donatella Donati[†]
donatella.donati@univaq.it

ABSTRACT

In this paper I argue that dispositionalism is the metaphysical theory that can best contribute to the construction of a metaphysical model for Molecular Gastronomy. Molecular Gastronomy is better explained if physical and chemical theories, which lie at the heart of Molecular Gastronomy, and cooking phenomena in general are described in terms of dispositions. This is the reason why trying to construct a metaphysical model for Molecular Gastronomy by using a dispositional metaphysics is a challenge worth taking on. I will thus explore what happens when we bring dispositions in the kitchen, and so the intersection between food, science and metaphysics.

The main aim of the paper is to pave the way towards the development of a metaphysical model for Molecular Gastronomy, rather than to construct it. In the first section, I will briefly reconstruct the history of Molecular Gastronomy, give a definition of it, outline its program and why a metaphysical model of MG is needed. In the second section, I will broadly describe the version of dispositionalism that I adopt in this paper. In the third section, I focus on two case studies and motivate the "dispositional choice". In the fourth and final section, I will draw my conclusions and raise some issues which are worthy of further investigation.

1. Molecular Gastronomy: What Is It?

The principles of Molecular Gastronomy lie at the heart of lots of chefs' culinary philosophy. Chefs all around the world invent new recipes thanks to scientific discoveries and experiments, and their cuisine is becoming increasingly popular: think about liquid nitrogen used to cool food very quickly.

[†] Università degli Studi dell'Aquila, Italy.

The meaning of "Molecular Gastronomy" has changed throughout the years and for this reason it is difficult to find a univocal definition within the literature. Roughly, it can now be said that Molecular Gastronomy is a scientific discipline that studies the phenomena that occur during the preparation of dishes in domestic and restaurant kitchens. In this section, I will briefly outline its history and its main interests and goals.

Although during 18th and 19th centuries various scientists explored different aspects of cooking, "Molecular and Physical Gastronomy" is officially born in 1988, from a common interest in cooking processes of Hervè This and Nicholas Kurti, a physical chemist and a physicist, respectively. They first named this new discipline "Molecular and Physical Gastronomy", which in 1998 turns into "Molecular Gastronomy"[1]. Molecular Gastronomy soon becomes a new scientific discipline studied in various university courses around the globe.

The main interest that lies behind Molecular Gastronomy (MG, henceforth) is figuring out the chemical, physical and biological phenomena that underpin culinary processes, and so transformations of food at home and at the restaurant[2], places where cooking has been usually governed by anecdotal and traditional knowledge. Why do potatoes soften during cooking? Why do soufflés inflate? Is it true that putting a cork in the boiling water where an octopus is being cooked prevents its meat from hardening? One of MG's aims is to give scientific replies to this sort of questions. As This says:

> My purpose is not to destroy or deconstruct our traditional ideas about cooking, but rather to renew a heritage: cooking that we have inherited from the past and that has gone unquestioned for centuries. What should we conserve from the past? What can we do without in the future? What can we transform and improve? Science can help us answer these questions." (2009: xiii)

The aims of MG are primarily two. First, to create new scientific knowledge. Second, to use this new knowledge to develop new ways of cooking that are rooted in science, because not only the understanding of the chemistry and physics of food and its constituents allows creativity to flourish and, consequently, a highly innovative cuisine, but also it allows to prepare food in

[1] "It was obvious to us that to characterize this particular part of gastronomy would require using an adjective such as *chemical* or *physical*, but in order to avoid excluding any particular science, the term *molecular* was chosen." (This, 2010)

[2] The focus till that moment had been on the chemical composition of ingredients and on the industrial production and nutritional properties of food (See Myhrvold and This, 2018: 1).

the best way possible, indeed "(...) even the humble hard-boiled egg with mayonnaise will enable us to wing a third star, if we set ourselves the task of making the perfect hard-boiled egg." (This, 2009: 1523)

Being a scientific discipline, MG makes use of the experimental method to reply to the sort of questions I considered above, as well as physics uses it to reply to questions such as "why do negative charged particles attract positive charged particles?". MG therefore brings science and its method into the kitchen in order to study and explain the mechanisms behind cooking.[3] After all, "[t]o cook is to use ingredients, which is to say complex physicochemical objects." (This, 2009: 112)

The starting point of MG's program are recipes: any culinary recipe realized at home and at the restaurant is transmitted throughout the years and brings with itself a definition of the dish, some technical information to realize it (a list of ingredients and a protocol to process them), and some additions to the recipe, such as proverbs, tips, tales, and so forth[4] (MG calls these additions "culinary precisions"). So, MG scientifically approaches the concept of recipe by providing a tripartite analysis of it; and along the analysis a program to study them.[5] A recipe is then composed by:

1. Some technical information;
2. A definition of the dish;
3. Culinary precisions (proverbs, tales, tips, methods, etc.)[6]

Given that recipes bring with themselves years (or centuries) of history, culinary activity clearly does not stop to the mechanisms behind food transformations, but it has also to do with the consumption of dishes, MG is also interested in the scientific exploration of the artistic and social aspects of cooking (of course, when preparing a dish one of the the aims is to prepare it in a good way, but a dish becomes good when consumed). So, the scientific program of MG, starting from the analysis of recipes mentioned above, is the following:

[3] Cf. This and Rutledge, 2009: 659.
[4] Cf. Burke, This, Kelly, 2016: 1.
[5] Cf. Burke, This, Kelly, 2016: 2.
[6] Cf. This and Rutledge, 2009: 660.

1. Scientific exploration of the culinary definitions and precisions (via the experimental method);
2. Scientific exploration of the artistic aspect of cooking;
3. Scientific exploration of the social aspects of cooking.[7]

Nonetheless, when it comes to talk about "the main analytical questions" to which MG aims to reply, This and Rutledge remind us that the main ambition of MG "(...) is to discover new mechanisms behind phenomena. Because culinary transformations involve both physical and chemical phenomena, two kinds of studies are performed." (2009: 660). Indeed, when food undergoes a transformation three main things change: the physical microstructure of the dish, the chemical contents of the various compartments that make the dish, but also a mix of the two: the physical and chemical environment of the molecules that makes them to behave differently in different circumstances. [8] The main objective of MG is then to have a detailed description of the physical and chemical processes of transformations by using scientific methods: tons of science in the kitchen.

Yet, although strictly connected to the kitchen, where it has brought a scientific revolution, it is right, at least according to MG purists, to distinguish MG from culinary enterprise. Even though throughout the years MG has given rise to new ways of cooking and new ways of talking and thinking about food, it has nothing to do with this practical aspect of the cooking activity. Indeed, till 2000s MG had been a mixture of science, technology and communication, which are clearly different activities. But MG is a scientific discipline, a "field of research; it is neither a method of instruction, nor a technology, nor a technique." (This, 2009: 175) Indeed, "(...) by 2010 it had become clear that Molecular Gastronomy should be used to designate the scientific discipline that investigates the mechanism of phenomena that occur during culinary transformation, while the term Molecular Cooking (Cookery, Cuisine) should define the culinary trend in which chefs use the new tools, ingredients, and methods developed through research in Molecular Gastronomy." (This, 2010: 1) Molecular Cooking and Note-by-Note Cooking are applications of MG: the

[7] Cf. Burke, This, Kelly, 2016.

[8] "For example a toxic molecule like methyl chavicol - which is an important compound in the essential oil of tarragon and basil, and is teratogenic and carcinogenic, even at low doses - does not seem to be dangerous in the leaves of basil or tarragon (...)." (2009: 660-1)

former is a technique that involves the use of new techniques, tools and ingredients; while the latter is a technique that uses only pure compounds rather than traditional food ingredients.

It should now be clear that this focus on the physics and chemistry makes the artistic and social aspects of cooking are less important. Also for molecular cooking, knowledge of the physics, chemistry, although not sufficient, seems to be a necessary requirement (and maybe the most important one).

But why do we need to construct a metaphysical model for MG? I'd like to motivate the will to furnish a metaphysical model for MG by quoting Mumford and Tugby's definition of the metaphysics of science (2013: 14):

> [Metaphysics of science] is the study of the aspects of reality, such as kindhood, lawhood, causal power, and causation, which impose order on the world and make our scientific disciplines possible (that is, disciplines which are able to provide predictions - often novel - and offer explanations for new facts and anomalies within their given domain), and also the study of the metaphysical relationship between the various scientific disciplines.

Science is enabled and often shaped by some tacit metaphysical assumptions: kindhood, lawhood, causal power and causation are concepts widely used in science, but these are metaphysical tools needed to give order to the world and enable us to make prediction and explain phenomena. Being a scientific discipline that relies on physics and chemistry, MG should be explained in metaphysical terms.

2. Dispositionalism

Before outlining dispositionalism, I will make a couple of remarks. First, for the purpose of this paper, I will not attempt to address the question whether dispositionalism and its theory of causation are acceptable and I will not engage with defending dispositional causation from nomological necessitarianism and regularity theories. Rather, I will assume dispositionalism and its theory of causation and motivate my choice in the next section (section 3)[9]. Second remark: although dispositionalism comes into different versions, almost all dispositionalists accept the principles I will mention in what follows. Let's now turn to the outline of the view.

[9] I will just motivate my choice in the two case studies in the following section (section 3).

Dispositionalism is a realist theory about properties, a theory that has gained a significant number of defenders in the last three decades[10]. Dispositions (or causal powers[11]) are intrinsic to their bearers and characterize their causal behaviour, indeed they refer to what an entity can do[12]. They are *modal* properties, since, as Williams says "(...) their mode of presentation is not restricted to how they now appear. (...) In fact, even when they act, powers rarely produce all the manifestations they are capable of producing (...)." (2019: 47) Causation happens when dispositions manifest themselves. Let's unpack these claims by using an example. Consider an electron, which is an object that has the property of being charged. First, the disposition of being charged is dispositional in nature, that is it cannot be reduced to any more fundamental kind of entity. Second, saying that the property of being charged is intrinsic to the electron means that its instantiation does not depend on external factors.[13] Third, the property of being charged determines the behaviour of the electron in different contexts, so how the electron behaves under different circumstances. When colliding with a positron (its antiparticle, which carries a charge of the opposite sign) it gets annihilated and *produces* gamma ray photons. Finally, this property is real, even when unmanifested: the electron instantiates the property of being attracteble by protons even when it does not manifest it.

In the following part of this section, I will mainly focus on the concepts of manifestation, multi-tracking and mutuality, since these concepts will lead us to a dispositional theory of causation. As already said above, when an electron collides with a positron it gets annihilated, and this collision produces gamma ray photons. In this case, the electron finds itself under the circumstance of a collision with a positron. But what would happen if the circumstances were different? If the electron were placed in an electrostatic field, the properties of the field would make the electron accelerate. The same property of the electron, its charge, makes the electron act differently under different circumstances.

[10] Just to mention a few of them: Shoemaker 1980, Ellis 2001, Molnar 2003, Mumford 2004, Bird 2007, Mumford and Anjum 2011, Tugby 2013, Williams 2019.

[11] Although I am aware that there are some dispositionalists who argue that there is a the difference between dispositions, dispositional properties and causal powers, I will not engage with this issue in this paper. For the purposes of this discussion such a difference is not relevant, so I take dispositions, dispositional properties and causal powers to be the same thing.

[12] Shoemaker (1980) considers dispositionalism as "the causal theory of properties".

[13] Here, for the sake of the discussion, following Tugby (2013) I take intrinsicness to be defined as follows: "P is an intrinsic property of x if and only if x's having P is independent of the existence of distinct particulars and x's relation to them".

Most dispositions are able to make more than one thing: depending on their surroundings they can manifest differently, and this is the reason why dispositions are multi-track[14]. Such circumstances are nothing more than other dispositions, other "localized arrangements of other powers" (Williams, 2019: 49). This means that the same power can produce different overall effects depending on which other powers combine with it. Powers can thus have different partners for the production of different mutual manifestations." (Mumford and Anjum, 2011: 35)

> (...) it is the selfsame property doing all these different things as part of different constellations. Change the circumstances in which a cubical object finds itself, and there is every reason to think that the resultant manifestation will change, too." (Williams, 2019: 80)

If the circumstances are just clusters of other dispositions, and dispositions behave differently depending on the dispositions they interact with, then powers have 'reciprocal partners' (or 'mutual manifestation partners') with which they produce different kinds of manifestations. When coming together, powers jointly produce a manifestation. These required circumstances are called constellations by Williams (2019), clusters by Mumford and Anjum (2011), powers nets by Martin (2008). Clearly, these partners must be appropriately arranged, since different arrangements give rise to different manifestations. Let's take back our electron: its charge makes it behave differently when interacting with different properties. This means just means that its charge has different mutual manifestation partners (or reciprocal partners) for the production of different manifestations.

Within the dispositional literature, causation is differently modeled[15], but when there is some change in the world (annihilation of a particle, production of gamma ray photons, acceleration), all dispositionalists believe that there are some powers that are jointly producing a manifestation. A mutual manifestation of powers is nothing more than the production of a new state of affairs and all powers in a given situation contribute to the production of a new state of affairs in the world. To state this more clearly, I will quote some of the most prominent dispositionalists:

[14] There are also single-track powers, those which can manifest in a single way (see Williams 2019: 79-85 for further discussion).

[15] Just to mention some of them: causal networks (Martin 2008), vector model (Mumford and Anjum 2011), constellations (Williams 2019).

> (...) a huge group of disposition entities or properties which, when they come together, mutually manifest the property in question (...). (Martin, 2008: 50)

> (...) we are better off thinking of causal networks, what Martin (1993, 2008) calls powers nets. Powers nets are evolving, massively cooperative ventures among the powers, constellation of causing, mutual manifesting among intertwined reciprocal partners. (Heil, 2012: 123)

> According to the causal dispositionalist theory, the cause of each process is the various mutual manifestation powers that, having come together, do their joint work and go through a transformation: a change of properties. (Mumford and Anjum, 2013: 126)

> (...) the production of the manifestation is a mutual affair. (...) The powers of the water contribute as much to the salt's going into solution as do the powers of the salt – there is no metaphysical sense in which any power involved is any less than any other. It is a case of cooperative powers all around. (Williams, 2019: 124-5)

This is what causation is, at least in a dispositional view. I am aware there would be much more to say about causation, and I am also aware that this is a controversial account, but let me remind that defending dispositionalism and comparing it with alternative theories is not the aim of this paper.

3. Towards a Dispositional Model for Molecular Gastronomy

Having given what I hope to be a charitable reconstruction of both MG and dispositionalism, we can now turn the reasons why dispositions could furnish the best heuristic for the construction of a metaphysical model for MG.[16] Let me briefly remind that MG is the discipline that is interested in the physical and chemical processes that occur during cooking. By exploring and understanding such processes from a scientific perspective, scientists come to understand how food behaves when undergoing culinary transformations. Also, by doing this, MG can prove tips, traditional practices, tales, proverbs and beliefs on food preparation right or wrong: "Scientific explanations are already appearing for many old and seemingly obscure culinary tricks." (Kurti and This, 1994: 66) As a consequence, by understanding how the properties of food behave during

[16] Here I am not very concerned with the distinction between Molecular Gastronomy and Molecular Cuisine, since the latter applies the principles advanced by the former the dispositional model works for both.

cooking, MG is able to furnish scientific principles that cooks can apply in order to create new recipes and make sure that food properties are manifested in the best way possible. Indeed, Kurti and This state that "(...) it is the duty of scientists to acquaint culinary artists with principles and techniques that may stimulate their imagination, just as they have previously done for painters, composers and musicians." (1994: 66)

In this section I will argue that the ingredients that we need to construct a metaphysical model for MG are dispositions and their interactions. Let's have a look at the following quote by Kurti and This (1994: 66), the founders of MG:

> Physics is beginning to explore the state of emulsions, suspensions, solid dispersions and foams (...) Advanced structural chemistry can now elucidate the behavior of large molecules such as complex carbohydrates and proteins. New chromatographic methods make it possible to isolate the components of foods that give rise to tastes and smells.

From a dispositional perspective, this quote is full of dispositional concepts: the *state of* emulsions, suspensions, solid dispersions and foams, the *behavior of* carbohydrates and proteins, components that *produce* the taste and smell of food. Looking at the state, at the behavior and at the production of something means looking at how its properties behave. In what follows, I will motivate the view that MG and dispositionalism are good bedfellows by considering two simple case studies.

Case 1. Here is a long quote from Hervè This' *Building a Meal*:

> It is often said that in order for a steak to be properly cooked, it must be seared because the crust that forms on the surface prevents the juices from escaping. (...) The reasoning is false, (...) but the conclusion is true. Let's compare two pieces of the same meat, one of which is quickly seared and the other slowly cooked. In the latter case, gradual heating causes the collagen to contract, with the result that the juices run out thereafter slowly evaporate. In effect, because the evaporation of these juices limits the surface temperature to 100°C (212°F), the meat boils in its juices. In the contrary case, when the meat is seared, a thin crust is formed by the rapid evaporation of the water on its surface. A thermometer placed beneath the surface of the meat shows that the temperature rises considerably, far above the boiling point. This is why the surface browns, as a result of various chemical reactions: oxidation, hydrolysis, Maillard reactions, and so on. (...) The meat remains tender because the inside is rare. Classical cuisine was therefore right to insist that meat be seared as quickly as possible, but not for the right reasons. (2009: 1256)

In order to explain this case study, I believe that a realist theory of properties such as dispositionalism is more efficacious than other (more abstract) metaphysical theories. First, from the way the example is presented, it seems clear that the behaviour of the steak depends on its physical and chemical properties and on the physical and chemical properties of the other entities it interacts with. From the descriptions of both the cooking processes, these properties seem to be real features of the world, entities that interact and are responsible for some a change in the world (e.g., a steak that from rare becomes cooked), because of their modal force. For this reason, I argue that dispositions seem to be the best candidates for the explanation of the scientific processes (both chemical and physical) that occur during food transformations. As Anjum (2020: 21) states:

> Dispositions are seen as plausibly real because they can explain what actually happens - the underlying principles of the behavior of things. (...) And our behavior very much reveals our understanding of dispositions as real and important.

What MG does is to individuate the correct dispositions and the correct reciprocal partners of these properties, and thus the manifestation that they jointly produce. Consequently, the belief that searing the meat produces tender steak can be proved wrong: it is not because the crust that it is formed on the surface prevents the juices from escaping, rather it remains tender because the inside is rare. In order to destroy false beliefs, what scientists do is to discover the disposition interactions and their manifestations. An old belief about a recipe can be so dismissed and replaced with a true one.

This kind of properties are hugely used to describe scientific phenomena but also have a huge impact on our lives: we are careful around what could be *potentially* harmful! Dispositions are then useful for making predictions and explain current situations. And for this reason dispositionalism seems to be more efficacious from an explicative point of view than other metaphysical theories of properties and causation.

Also, being a realist theory of properties, it can also account for properties that remain umanifested. As seen in the previous paragraph, dispositions are real also when they do not manifest themselves[17]. The fact the we decide not to cook the meat does not mean that its disposition of forming a crust does not exist, it is still there and it is real, in the same way a glass remains fragile even though

[17] Contrary, for example, to regularist theories, which rely only on what is observable.

it never breaks (its fragility is still a real feature of the glass). This way of considering properties is better than others in the kitchen: cooks know which properties a given food has, are aware that a certain food really has the potentiality to manifest a given property, but they decide which dispositions the food has to manifest. The multi tracking of dispositions better explains why the very same piece of meat ends up being two different things. As we have seen in the example, the manifestation depends on many dispositions working together, and these dispositions manifest differently under different circumstances. We have two different examples of how the same piece of meat can be cooked: the steak can be either seared or slowly cooked. The very same piece of meat, with the same properties, behaves in two different ways depending on the circumstances it finds itself into. The dispositions of the steak manifest differently depending on the mutual partners they interact with: in the case of a very hot surface, where the temperature is very high, the meat forms a crust, the water that is on it evaporates quickly, and its inside remains rare; in the case of slow cooking, where the heating is gradual, and the temperature is much lower and the juices of the steak slowly evaporate, and no thin crust is formed. Knowing the dispositions of the meat it is possible to individuate and select the dispositions that they have to interact with in order to have the desired manifestation that, as we have previously seen, is a mutual affair.

Finally, it is interesting to notice how the steak could be spatially divided: each part of the steak undergoes different (casual) processes. In the case of seared meat, the surface undergoes the Maillard reaction, a process that does not affect the inside of the steak. Each part of the steak "activates" different dispositions: by interacting with a very hot surface the outside of the steak undergoes a change that consists in a production of a thin crust, the inside of the steak, where the temperature rises but that is not in contact with the hot surface, remains rare. By decomposing food in its parts it is possible to individuate the changes that these parts undergo [18]. As a whole the steak undergoes a transformation too: it gets cooked. This reductionist approach to the cooking

[18] It would be interesting to investigate this point in more depth. How do we select our food depending on the processes it undergoes in its different parts? For example, we usually remove the skin of the apple that is a part of it and tat has undergone different transformations respect to its pulp. And how do food nutrients change depending on their dispositions' manifestations? Clearly, a cooked apple has different nutrients from a raw one.

processes hat could be used to analyze the scientific processes from a metaphysical point of view. And dispositions seem to work well.[19]

Case 2. In the following quote, Burke, This and Kelly are describing a dairy free version of Irish coffee invented by a student of the Dublin Institute of Technology School of Culinary Arts and Food Technology: "(...) the chemical and physical properties of an egg or its components are exploited in order to substitute it for other usual components and thereby create an innovative drink or dish (Sciences-Cuisine, 2013). In the example shown, the student exploited the properties of egg constituents to create a dairy-free version of Irish coffee for lactose intolerant consumers. A sabayon is a light sauce traditionally made with egg yolks, sugar, and wine (typically Marsala), and in Italy it is called 'Zabaglione'; the recipe for the egg sabayon included the following ingredients: egg yolk, white refined sugar, water, Irish whiskey, xanthan gum and gellan gum (polysaccharides produced by bacteria), and white coloring. The lightness of the egg-based sauce coupled with the addition of xanthan and gellan gums allowed a stable 'creamlike' layer to remain above the coffee layer during consumption." (Burke, This, Kelly, 2016: 5)

Also this case lends itself to an explanation in dispositional terms. In this second case, I will focus on two different aspects. First, in a traditional Irish Coffee the 'creamlike' layer is usually made of dairy cream, in the dairy-free version of it, the student has used different components to create a layer which, apparently, has very similar dispositions to the original one: it is white, creamy, light, stays on the coffee when consumed. The student identifies the dispositions of the original cream layer and the way in which its components interact and manifest, and looks for alternative ingredients that when interacting produce very similar manifestations. The scientific knowledge of the dispositions of the dairy cream allows the student to find compounds that by interacting can produce a layer perceptually equal to the one made of whipped cream, and so to reproduce the Irish coffee recipe by using components that can substitute most of the ingredients and give equal perceptual dispositions.

This case raises a second interesting issue. When looking a the two versions of the Irish coffee it is not possible to distinguish which is which, nonetheless the two are quite different: the dispositions of their nutrients are not the same

[19] An interesting aspect that is worthy of further investigation is the following: some dispositions (such as "being cooked") are not in the vocabulary of the chemistry and the physics, but are in the vocabulary of MG and its applications. Such dispositions are realized by some chemical and physical phenomenon, but from a perceptual point of view they seem to be genuine properties.

(e.g., in the dairy free version there is no whipped cream and so there are no dairy fats). Being impossible to distinguish the two versions just by looking at them, it seems that the dairy-free version of the recipe preserves the identity of the dish. Is it then sufficient for a dish to retain its perceptual and aesthetic properties in order to retain its identity? Are these the aesthetic dispositions of the dish? If so, then the identity conditions of a dish are given by a subset of the dispositions of the dish: the aesthetic ones. Should then the identity of the dish be reconsidered? There are a couple of options: either the identity of the dish is amplified and the dairy-free version of Irish coffee has to be considered to be real Irish Coffee or aesthetic properties are not enough to fix the identity of the dish and the dairy-free version of the dish cannot be considered Irish coffee. Both the options seem to be reasonable: the original Irish coffee and its dairy free version look alike and so share the same aesthetic dispositions. Being impossible to visually distinguish the two, the dairy free version seems to preserve the identity of the dish. Nonetheless, the nutrients of the two versions are different, and so their nutritive dispositions: being so different from a nutritional perspective, the dairy-free version seems not to satisfy the identity conditions of the dish. The question is: is there a subset of dispositions that have the role of fixing the identity of a dish or are the dispositions of a dish as whole to fix its identity? This is an aspect that I believe to deserve further consideration.[20]

In both cases, it is dispositionalism can provide a good explanation. But let me also add a further motivation for choosing dispositonalism over other metaphysical theories of properties and causation. Dispositionalism is a singularist theory of causation: "Causal singularism is the ontological view that causality happens in the particular case and does not require repetition". (Anjum, 2020: 20)

Contrary to regularity theories, for example, where repetition is the key and the same cause should always produce the same effect, and so where there

[20]Another case study, related to this, that would be worth analyzing in depth is spherification, a process that comes from the mixture of sodium alginate (a thickening agent extracted from seaweed) and calcium chloride that allows for a transformation of a liquid into a sphere with a membrane made of gel. The liquid is immersed in the mixture of sodium and calcium, and each droplets of the liquid gets incapsulated in a bubble, which is then rinsed off and served. It has been invented by Ferran Adrià, a Spanish chef, and now widely used in modernist cuisine. The aim of 'spherifying' a liquid is to have a particular textual sensation: when the sphere gets bitten, it releases a burst of flavor in the mouth. Also in this case, dispositions are in play: creating a dish like this is all about the study of interaction among the dispositions chemical compounds.

cannot be a single instance of causality, dispositionalism can account for singular cases os causation. A steak could behave differently from other steaks of the same type: it could instantiate different dispositions because of the way it was stored or because of the way the animal was reared, and so its dispositions, under the same circumstances, could manifest differently than dispositions of other steaks. And again, this is because dispositions can account and explain single and unique cases of causation.

Knowing the behavior of dispositions under different circumstances allows to reach the situation where they manifest "in the best way possible", and to find different compounds that could manifest similarly. The investigation of the physical and chemical modifications and so the physical and chemical transformations that obtain during cooking processes, but also the physical and chemical environments of the molecules, could then be modeled with dispositions and their interactions: there is no magic, "(...) all the causal magic is right up in front for all to see. States of the world – none other than the arrangements of powers that are the constellations – give rise to the later states of the world that are their manifestations." (Williams, 2019: 129)

4. Conclusions

In this paper, I have argued that Molecular Gastronomy can be explained in dispositional terms, and so that dispositonalism could furnish a model for MG. In order to show this, I presented two simple cases studies and described them by using dispositional concepts. Surely, this paper leaves several questions unanswered, but its aim is to pave the way toward the study of the intersection of dispositionalism and Molecular Gastronomy.

Some questions, although not all metaphysical, that are worthy of further investigation are the following: is the scientific approach promoted by MG really necessary for a good cuisine? Is it really necessary to understand the scientific processes behind cooking in order to introduce novelty in the kitchen? What role do the history, the tradition and so the social and artistic value of recipes play? Is it possible to analyze these aspects in dispositional terms too?

REFERENCES

Anjum, R. L. (2020). Dispositions and the Unique Patient., in Anjum R. L., Copeland S., Rocca E. (eds.). *Rethinking Causality, Complexity and Evidence for the Unique Patient*. Springer Open.

Burke, R., Kelly, A. L., This, H. (2016). Molecular Gastronomy: An Introduction, Reference Module in Food Science, https://doi.org/10.1016/B978-0-08-100596-5.03384-9

Burke, R., Kelly, A. L, This, H. (2016). Molecular Gastronomy, Reference Module in Food Science, https://doi.org/10.1016/B978-0-08-100596-5.03302-3

Ellis, B. (2001). *Scientific Essentialism.* Cambridge University Press, New York.

Heil, J. (2012). *The Universe as We Find It*. Oxford University Press, New York.

Kurti, N., This, H. (1994). Chemistry and Physics in the Kitchen. *Scientific American*. 270 (4): 66-70.

Martin, C. B. (2008). *The Mind in Nature*. Oxford University Press, New York.

Molnar, G. (2008). *Powers*. Oxford University Press, New York.

Mumford, S., Anjum, R. L. (2011). *Getting Causes from Powers*. Oxford University Press,New York.

Myhrovold, N., This, H. (2018). Molecular Gastronomy. Encyclopedia Britannica. https://www.britannica.com/topic/molecular-gastronomy

Shoemaker, S. (1980). Causality and Properties, in P. Van Inwagen. (ed.). *Time and Cause: Essays Presented to Richard Taylor*. Reidel, Dordrecht: 109-35.

This, H. (2010). Molecular Gastronomy: The Science Behind the Cuisine. Encyclopedia Britannica.https://www.britannica.com/topic/Molecular-Gastronomy-The-Science-Behind-the-Cuisine-1707433

This, H., Rutledge, D. (2009). Analytical Methods for Molecular Gastronomy. *Anal Bioanal Chem*, 394: 659-661.

This, H. (2009). *Building a Meal: From Molecular Gastronomy to Culinary Constructivism*. Columbia University Press.

Tugby, M. (2013). Platonic Dispositionalism. *Mind,* 122: 471-86.

Williams, N. (2019). *The Powers Metaphysic*. Oxford University Press, New York.