

# What is food? An investigation into food realizables

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## Abstract

Food materials are largely characterized by their potentialities, which are captured in the OBO Foundry as realizable entities. Here, we identify various kinds of food-related realizable entities to analyze which ones might be essential to the status of food. Edibility, nutritiveness and palatability are three dispositions often found in food materials that are conceptually independent from each other. We argue that none of these dispositions is necessary nor sufficient for being food. Instead, we argue that food materials are defined by having an appropriate food role: a role of a material entity of a type that is globally considered by a community as appropriate for consumption by ingestion in order to fulfill nutritional needs and/or provide organoleptic experiences. We explain how these notions can address some shortcomings of definitions of high-level food-related entities in current ontologies or philosophical analyses of food.

## Keywords

Food material, Realizable entity, Disposition, Function, Role, Edibility, Nutritiveness, Palatability

## 1. Introduction

Food appears to be a highly heterogenous category: it is hard to find something in common among the different things that people eat [1]. In the Food Ontology FOODON [2], *Food\_material* is defined as:

(DEF<sub>FM</sub>) “Any substance that can be consumed by an organism to satisfy nutritional or other health needs, or to provide a social or organoleptic food experience”.

Although this definition captures some essential aspects of food (see also the related “physical” definition of food by Borghini & Pinas [3]), it is uncertain whether it provides a necessary and sufficient condition for something being food. For instance, I *could* consume my

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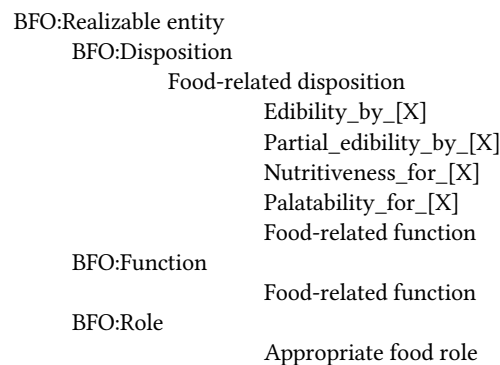
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rabbit pet or the flesh of my neighbor to satisfy my nutritional needs, but whether these are food is, to say the least, debatable. Thus, further inquiries are required.

The word “can” in the definition indicates that food is defined relative to a *potentiality* of consumption for certain goals. Potentialities are classically represented in BFO by realizable entities: dispositions (which include functions) and roles. In a similar spirit, CHEBI’s [4] analysis of food revolves around the core notion of *Food role* as follows:

(DEF<sub>FR</sub>) “A physiological role played by any substance of either plant, animal or artificial origin which contains essential body nutrients that can be ingested by an organism to provide energy, promote growth, and maintain the processes of life.”

Since BFO is the upper ontology used by FOODON (and more generally by ontologies from the OBO Foundry, including CHEBI), we will deploy our analysis in this context. In this paper, we will analyze in this paper the realizable entities that seem to be relevant for something being food, and discuss how they should appear in a necessary and sufficient condition for being food, leading to the following taxonomy of realizable entities:



**Figure 1:** Relevant food-related realizable entities (X is any group of organisms, e.g. Human)

In section 2, we will investigate relevant dispositions, in particular edibility, nutritiveness, and palatability. In section 3, we will analyze the notion of appropriate food role. In section 4, we will consider which of those realizables are relevant for classifying some material entities as food. In section 5, we will compare our proposal with definitions in existing applied ontologies. A discussion and conclusion will follow.

## 2. Food-related dispositions

We can identify three dispositions frequently associated with food, that we can name “edibility”, “nutritiveness” and “palatability”. As we will see, they are largely independent of each other in the sense that a material entity can bear an instance of one while bearing or not an instance of another. These dispositions might be BFO:functions in some cases. Although such dispositions are present in many food items, we will see in section 4 that they are neither necessary nor sufficient conditions for being food; thus, we will call them “food-related dispositions”.

## 2.1. Dispositions in BFO

A BFO:disposition is a realizable entity that inheres in some material entity and is such that if it ceases to exist, then its bearer is physically changed. Its realization occurs when and because this bearer is in some special physical circumstances (the trigger), and in virtue of the bearer's physical make-up (which has been named its "categorical basis" [5,6]). Classical examples include fragility (the disposition to break when pressed with a force) and solubility (the disposition to dissolve when put in a solvent). Dispositions may exist even if they are not realized or even triggered: for example, a glass is fragile even if it never breaks or even if it never undergoes any shock. As we will see, three dispositions are often possessed by food items: edibility, nutritiveness and palatability.

## 2.2. Edibility

As a starting point, let's consider PATO's [7] definition of "edibility" as follows:

*(ED<sub>PATO</sub>) Edibility*:<sub>=def</sub> A physical quality inhering in a bearer by virtue of the bearer's disposition to being fit to be eaten.

This definition suggests that edibility is the categorical basis of a disposition, namely the fitness of the bearer to be eaten. We can distinguish here two entities: the disposition and its categorical basis. The etymology of the word "edibility", however, suggests a dispositional character. Therefore, this label would arguably fit better with a disposition than with its categorical basis.

ED<sub>PATO</sub> does not specify by whom the bearer is fit to be eaten. As it happens, a material can be edible by some species but not by another – for example, sugar is edible by humans, but not by dogs as it can cause some health risks to them. Thus, one should rather speak of "Edibility for humans", "Edibility for dogs", etc. These considerations lead us to the following definition:

*Edibility\_for\_humans*:<sub>=def</sub> A disposition of being fit to be eaten by a typical human.

In the rest of the paper, "edible for humans" will be abbreviated as "edible". Being "fit" to be eaten can be defined in terms of risks: the consumption of an edible (for humans) material by a typical human does not create significant risks for them (for ontological analyses of risks, see [8,9]). The edibility disposition of a material entity is triggered by the material being consumed by a typical human and realized by the entity being ingested and digested by this human without causing harmful consequences.

Note that an edible material entity might still be unfit for consumption by some humans, for example by people allergic or intolerant to it – hence the introduction of the term "typical human" (we will not discuss this notion of typicality here). One could introduce finer dispositions to account for this: a material entity may bear the dispositions *edible\_by\_human<sub>1</sub>*, *edible\_by\_human<sub>2</sub>*, but have no such disposition for *human<sub>3</sub>*, etc. (such dispositions would be, in the framework of Toyoshima et al [10], extrinsic dispositions, as they depend on something external to their bearer – see also section 6).

Edibility can come into existence and cease to exist. Raw cassava is toxic but becomes edible when cooked: thus, raw cassava is not edible, but has a predisposition to become edible. Conversely, most edible entities have a disposition to become inedible over time [11]. An apple,

for example, has a disposition to rot – in which case it will not be edible anymore (that is, it will lose its edibility disposition).

Edibility is also a matter of degree in at least two ways. Many food products might cause some health risks in the long run (think about junk food). To take a more exotic example, some humans regularly eat dirt (typically chalk or clay) – a practice named “geophagia”. The consumption of such materials can cause moderate risks, and thus their edibility is a matter of degree. Edibility thus joins the long list of ontological notions for which vagueness is an issue [12]. Also, the edibility of a material entity can depend on its quantity: a small amount of saffron or apple seeds is edible (it carries an instance of edibility), but a large amount is poisonous (it does not carry such an instance). Similarly, prepared fugu flesh in which remains a small amount of tetrodotoxin is edible, but it would be inedible if a large amount of this molecule remained.

Note that we do not consider only health-threatening risks in the definition of edibility. Thus, in this framework, digestibility is one of the components of edibility (it might be considered as a dispositional part of edibility [13]): a material that is not easily digestible could cause some minor digestive issues that are not health-threatening; in the most extreme case, it might be considered inedible. But a material can be digestible and not edible (consider a poisonous apple).

Note that with this definition of edibility, many materials commonly qualified as “edible” would not be edible. A coconut, an avocado, a banana, a chewing gum, a peach or even a sunflower seed in its shell might not be edible according to this definition, as the consumption of the whole material (including kernel, skin and/or shell where applicable) might create some risks for the digestive tract. Therefore, one could introduce another notion of partial edibility:

*Partial\_edibility\_for\_humans*:=<sub>def</sub> A disposition borne by a material entity of having a part being fit to be eaten by a typical human.

This disposition is triggered by *a part* of the material being consumed and realized by this part being ingested and digested without causing harmful consequences; however, it inheres in the whole material (see a related discussion on qualities in section 4.5.2 of [14]). Arguably, the common notion of edibility is better captured by this notion of partial edibility: the materials mentioned above (coconut etc.) are *partially* edible. In the remainder of the paper, we will use the term “edibility” to refer to this notion of partial edibility by humans.

### 2.3. Nutritiveness

Edibility, however, is not the only relevant disposition for food. “Being fit to be eaten” means that the consumption of the material would not cause risks to a typical human. But food should not only be safe for consumption, it should also typically bring nutrients. For this reason, we can introduce another disposition named “nutritiveness”:

*Nutritiveness\_for\_humans*:=<sub>def</sub> A disposition borne by a material entity that is realized by providing nutrients when eaten by a typical human.

While edibility characterizes the absence of negative consequences, nutritiveness characterizes the presence of positive consequences. Edibility and nutritiveness are

conceptually independent of each other. For example, a paracetamol oral pill is edible, but it is not nutritious (it has other benefits though, which explain why it is consumed); similarly, diet food might be largely un-nutritious. On the other hand, a poisoned apple is nutritious (it can provide nutrients when eaten) but inedible (it might kill its consumer).

As with edibility, we might introduce finer dispositions “nutritious\_for\_organism<sub>i</sub>” involving a specific organism. There might be less variability between one person and another in terms of nutritious character than for edibility, although this remains an empirical question (even identical twins can have different gut biomes).

## 2.4. Palatability

A third disposition that can be relevant for characterizing food is its “palatability”, which we might define in terms of organoleptic experience (following FOODON’s definition of “Food product”) as follows:

*Palatability\_for\_humans*:<sub>def</sub> A disposition borne by a material entity that is realized by providing a positive organoleptic experience<sup>2</sup> when being consumed by a typical human.

A material can create a negative or positive organoleptic experience because of its taste, aroma, texture, temperature (think about warm tomato soup or ice cream), sound (think about the crunch of bread crust, crisps, tempura or crispy lettuce when being eaten) and/or appearance. Palatability might vary from person to person even more than edibility: clearly, personal food preferences can vary a lot (the social aspects of palatability will be considered below in section 3). Examples that illustrate this variability encompass Swedish surströmming (and other fermented fish products such as Japanese kusaya and Icelandic hakarl), durian, liquorice, coriander, natto, snails, century eggs, blue cheese, marmite/vegemite or pineapple on pizza. Palatability might also depend on the circumstances: some foods fit better with some others (chocolate might taste less good with gravy, or some wine might not fit with some foods); acidic materials might taste better after having eaten miracle fruit, which changes the perception of acidity into sweetness. This variability can be captured by the conditions that would trigger a palatability disposition.

## 2.5. Other dispositions of food materials

Some food materials (or materials germane to food) might carry other dispositions than edibility, nutritiveness and palatability, and may be consumed with the goal of activating such disposition. For example, alcoholic beverages and various cannabis edibles have dispositions to create psychoactive experiences. To take another example, caffeine, alcohol and other food

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<sup>2</sup> Note that some products might produce a positive organoleptic visual experience that does not require consumption to provide it (consider e.g. Christmas candy canes). This would motivate the introduction of a similar disposition, with a different label limited to visual experience – or to introduce a more general disposition that encompasses both palatability and the capacity to provide positive visual experiences. Also, some food items can provoke a positive audible experience before they are eaten (think about the popping sound of popcorn or a bottle of champagne, or the cracking sound of the crust of crême brûlée).

products have dispositions to increase gastrointestinal motility. Such dispositions, however, are arguably not defining features of the folk concept of food.

## 2.6. Connections between edibility, nutritiveness and palatability

Palatability might be correlated with edibility and nutritiveness, presumably through the work of evolution (it is an evolutionary advantage to enjoy eating what is nutritive and not risky – but think about counterexamples such as visually appealing poisonous mushrooms). However, conceptually, edibility, nutritiveness and palatability are largely independent of each other, as illustrated by the examples provided in table 1 below.

**Table 1**

Examples of products classified based on the presence (Y) or absence (N) of edibility, nutritiveness and palatability

	<b>Edible</b>	<b>Nutritious</b>	<b>Palatable</b>
<b>Ripe apple</b>	Y	Y	Y
<b>Unflavored protein powder</b>	Y	Y	N
<b>Flavored diet food</b>	Y	N	Y
- Bland diet food - Unflavored paracetamol pill	Y	N	N
- Poisoned ripe apple - Some deadly mushrooms	N	Y	Y
<b>Poisoned unripe apple</b>	N	Y	N
- Extremely warm flavored diet food - Chewing tobacco	N	N	Y
<b>Extremely warm bland diet food</b>	N	N	N

Note that palatability and edibility are partially connected: if a material item tastes bad, then it can create some discomfort for its consumer. Therefore, unpalatability might imply some light degree of inedibility.

## 2.7. Food-related function

BFO defines the term “function” as follows: “a disposition that exists in virtue of the bearer’s physical make-up and this physical make-up is something the bearer possesses because it came into being, either through evolution (in the case of natural biological entities) or through intentional design (in the case of artifacts), in order to realize processes of a certain sort.” (see [15] for a defense).

Some food-related dispositions are actually design BFO:functions. For example, if a processed food is brought into existence by a production process, then its edibility, nutritiveness and palatability exist in virtue of a physical make-up that the manufacturers intentionally designed so that those realizable entities could be realized – and thus those dispositions are design BFO:functions. A chocolate cake or *in vitro* meat, for example, bear such design functions; on the other hand, the edibility, nutritiveness and/or palatability of the flesh of a hunted animal are not design functions, since its flesh was not intentionally designed to bear such dispositions – it was at most *arranged* to create or enhance such dispositions. The same can be said of an edible, nutritious and palatable fruit occurring in the wild that would not have been historically genetically engineered.

Are some of those dispositions the results of evolution and thus biological functions? This is debatable: it is arguably the lion who has evolved to eat the antelope, rather than the antelope who has evolved to serve as food to the lion. More specific investigations in the biological literature on evolution are needed though to verify whether in some cases, such food-related dispositions might be biological functions.

### 3. Food role

We now need to turn to other relevant realizable entities, namely roles. Food has clear roots in cultural and personal preferences: intuitively, one might think that what is considered food in one culture (e.g. surströmming) might not be considered food in another; or what is considered food for one person (e.g. meat for an omnivore) might not be considered food for another (e.g. for a vegetarian or vegan person). What differentiates my pet rabbit from a rabbit raised for meat is typically the circumstances in which it is raised, not some BFO:dispositions (which are intrinsic). Food acceptability might vary according to ethical, religious and cultural principles, as well as personal relationships (such as this rabbit being my personal pet). Thus, we need to investigate relevant roles.

#### 3.1. Appropriate food role

We can introduce the following notion of *Appropriate food role* (where “agent” can refer to anything with agency – typically an organism or a community of organisms):

(AFR) *Appropriate food role* :=<sub>def</sub> A role of a material entity of a type that is generally considered by some agent as appropriate for consumption by ingestion in order to fulfill nutritional needs and/or to provide organoleptic experiences<sup>3</sup>.

Example of material entities that would bear an appropriate food role because they can provide some organoleptic experience even if they don't have significant nutritional value include candies, chips, cookies or alcoholic drinks.

A pork rib served in a vegetarian, vegan, Muslim or Jewish community would not bear an appropriate food role; but it might bear an appropriate food role if it were served in an omnivore community. Cooked human flesh would not carry an appropriate food role in most communities but might carry such a role in a cannibalistic society. A consecrated host would presumably not bear an appropriate food role for Catholics, as it is not considered food anymore but as the body of Christ: it is supposed to be consumed, but not in order to fulfill nutritional needs or to provide an organoleptic experience. A statue made of chocolate and designed to be appreciated visually but not to be eaten might be edible, nutritious and palatable (dispositions that are here *not* functions, since the statue is not designed to be eaten), but does not bear an appropriate food role: people might consider inappropriate to eat such a work of art.

Roles are essentially relational entities: a (relational) role appears in an independent continuant when this independent continuant is somehow related to other entities [16]. One

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<sup>3</sup> Note that here too, we might relativize this notion: “appropriate food-for-humans”, “appropriate food-for-lions”, etc. And even further, we might introduce the notion of which agent A considers this product as appropriate or not appropriate for humans, for lions, etc., by introducing the relations: “appropriate-for-A food-for-humans”, etc.

might get a finer-grained view of roles by introducing the relation that defines an appropriate food role. Thus, we might introduce the relation `appropriate_food_for` that would relate some material entity to an agent. A pork rib might be related by `appropriate_food_for` to Mark, who is a meat eater, but not to John, who is vegan. This relation might arguably be considered more primitive and useful than the class *Appropriate food role*, although such a class might also be useful for some practical goals.

### 3.2. Other food roles

Food might bear a variety of other roles: it can evoke memories, fulfill traditions or be connected with heritage. By doing so, it might provide a sense of comfort, nostalgia or belonging, or fulfill a liturgical role. All these roles, however, are arguably not definitional features of food, but non-definitional characteristics. Therefore, we will not investigate them in more detail here.

### 3.3. Appropriate food role: Discussion

Appropriate food roles might be a complex matter. Consider, for example, a community of survivors of a plane crash that have to eat their dead companions to survive. The flesh of their companions instantiates two classes: *Human flesh*, which is not considered appropriate for consumption to fulfill nutritional needs, and *Human flesh of dead people after a plane crash surrounded by starving survivors*, which might be considered appropriate for consumption by those survivors. This can explain the ambivalence the survivors might have about eating it.

Bearing an appropriate food role may influence the evolution of some dispositions such as palatability: for example, living in a vegan environment where meat does not have an appropriate food role might cause people in this community to become disgusted by the taste of meat. Conversely, living in a cannibalistic society might diminish the disgust that many people have for the idea of eating human flesh.

The notion of appropriate food role is at the root of what can be called a “food social experience” (see FOODON’s definition  $DEF_{FM}$ ). A food social experience could be defined as an experience of consuming a product in a community for the members of which this is an appropriate food. Any common shared meal or wine tasting session would belong to this category. Or to take a less common example, consider a gathering of chalk eaters to eat chalk together: their chalk items belong to a kind they consider appropriate for consumption to fulfill an organoleptic experience, and this is thus a food social experience. A gathering of friends to smoke cannabis, however, would not be a food social experience, as the product is consumed to produce an experience which we do not classify as “organoleptic” but rather as “psychoactive”.

## 4. What is food?

The realizable entities identified in section 3 can help us define food. Note first that the term “food” seems to admit of a large variety of definitions. To provide a definition of it one would need first to formulate requirements – e.g., a clear set of use of the term “food” with which the definition should match. As there is a large variety of possible requirements, we will abstain from making a definitive choice here and will just provide considerations on how we might define the folk notion of food in terms of realizable entities identified above.



## 4.1. Edibility and food

Let us investigate whether edibility is a necessary, sufficient or necessary and sufficient condition for being food.

If edibility were a necessary condition for being food, then so-called “poisoned food” would not be food. Also, raw cassava would not be food: only cooked cassava would be. For this latter point, one might however relax the requirement by considering instead as necessary condition a *predisposition* to edibility (that is, a food material needs to have a predisposition to become edible if prepared in some way). A predisposition to edibility is probably not a sufficient condition though – otherwise, a pig living in the wild would be food, as it has a predisposition to become edible if cooked the right way.

Edibility of a material is also not a sufficient condition, as therapeutic examples show: a paracetamol pill is edible but is generally not considered food. It is also debatable whether edible packaging or edible underwear are food or not. Cooked human flesh is edible, but is generally not considered food in a non-cannibalistic society.

Therefore, edibility is arguably neither a necessary nor a sufficient condition for being food.

## 4.2. Palatability, nutritiveness and food

Let us now turn to palatability. Taste and aroma palatability seem to be optional characteristics of food – otherwise, sentences such as “This food is disgusting!” would not make sense. It is also arguably not a sufficient condition, as flavored medications are generally not considered food. Visual, temperature and auditory palatability also seem quite optional characteristics of food.

Nutritiveness might seem to be a better candidate for the status of food than edibility and taste/aroma palatability – and as it happens, it lies at the core of the definitions above  $DEF_{FR}$  and  $DEF_{FM}$ . However, as stated above, if nutritiveness were a sufficient condition for being food, then my rabbit pet or the flesh of any human would be food. Other debatable examples of food encompass dystopian visions of the future in which nutritional needs are fulfilled by nutritious pills - or to take a less science-fictional example, consider Soylent, a full meal replacement in the form of a shake, whose food status has been debated.

What science-fictional food pills (as well as Soylent meals to some extent) are missing in terms of intrinsic characteristics compared to typical food products is some kind of texture making it more palatable. But the debated case of Soylent, for which people might disagree about counting it as food or not, suggests that the texture requirement for a product to count as food is social: thus, food pills might often be considered as non-food primarily because of social norms too. This shows the importance of *social roles* in determining what is food.

Nutritiveness is arguably not even a necessary condition for food. Consider what could be a “perfect” weight loss food such as flavored cellulose, which would be un-nutritive. Or to take another example, consider the following “unnutritive food” thought experiment: in a society  $S$ , it is customary to eat a product  $P$  to fulfill nutritional needs. However, unbeknownst to members of  $S$ ,  $P$  has no nutritional value. If nutritiveness were a necessary condition, this would mean that  $P$  is not food and that members of  $S$  wrongly consider it to be food. But this seems to contradict our intuitions about food. Here again, it seems that it is the fact that members of  $S$  *believe* that  $P$  has nutritional value and accept its consumption for that reason that gives it a

status of food. This brings us, here too, to the importance of appropriate food role (AFR) in determining the food status.

### 4.3. Appropriate food role and food status

Social role seems to be at the root of the notion of food. Consider the definition of food by the Federal Food, Drug and Cosmetic Act, section 201(f): “The term “food” means (1) articles used for food or drink for man or other animals, (2) chewing gum, and (3) articles used for components of any such article.” Leaving aside the arbitrary specification of chewing gum, the obvious circularity in the first item is problematic<sup>4</sup>. But it might be rephrased in a non-circular way thanks to the definition of AFR proposed above: “Food Material” could be defined as “A material entity that bears an appropriate food role” – where the definition of “appropriate food role” does not use the notion of “food”. This would explain why some material entities that are edible and nutritious (and maybe even palatable in some cases) such as the flesh of a pet, cat food or human flesh are not considered to be (human) food.

If bearing an AFR is a necessary condition for being food, this would mean that an unknown fruit on a tree that is edible, nutritious and palatable, and that nobody has ever discovered, is not food<sup>5</sup>. This arguably matches some intuitions about food.

AFR mentions “of a type [considered as appropriate]”: even if I know that this apple has been poisoned, I can call it food (more specifically, “poisoned food”) as it belongs to a type (*Apple*) that is generally considered as appropriate for consumption, even if it also belongs to another more specific type (*Poisoned apple*) that is not considered as appropriate for consumption.<sup>6</sup>

However, if bearing an appropriate food role is a necessary condition for being food, it seems to imply that prohibited food does not exist – only material entities prohibited for consumption, which are thus not food. One might want to be able to speak of “prohibited food” though. However, this is possible even if we consider that bearing an AFR is a necessary condition for being food. Indeed, an item might bear an appropriate food role in a community but not in another community. Thus, “food prohibited in a community C” would refer to some material entity that does not bear an AFR for members of C (and thus is not food for them) but that bears an AFR for most members of a larger community that encompasses C (and thus is food for them).

Would bearing an AFR be a sufficient condition for being food then? As illustrated earlier, neither edibility, nor palatability and maybe not even nutritiveness (if one is convinced by the “unnutritive food” thought experiment) are necessary conditions for being food. Thus, bearing an AFR might be not only a necessary condition, but also a sufficient condition for being food.

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<sup>4</sup> But it might reveal a conception according to which food would be partly defined by fiat decisions (a bit similarly to some definitions of gender, such as “woman” being defined as “a person considering herself as a woman”).

<sup>5</sup> However, an apple that has never been seen by anyone would be food, as it is of a type that is considered as appropriate for consumption – even if this specific instance has never been perceived by anyone.

<sup>6</sup> Here, natural kinds might help to introduce some distinction (*Apple* is a natural kind but *Poisoned apple* is arguably not), but we will not enter into such considerations.

#### 4.4. Design functions and food status

Bearing instances of edibility, nutritiveness or palatability that are design functions is clearly not a necessary requirement for being food: a fruit picked from a tree and consumed is food, but does not have such functions (assuming neither it nor its ancestors have been cultivated or bred, its edibility, nutritiveness and palatability are non-function dispositions).

However, if something is manufactured in order to possess nutritiveness, edibility and palatability, then it presumably indicates that there is a market for it and thus some social acceptance of consuming it for fulfilling nutritive needs and/or providing organoleptic experiences. Thus, possessing some nutritive design function might be an indicator that something bears an AFR and is thus food. For example, the fact that insects are now marketed as food in some Western countries where they have traditionally not been eaten reveals that they bear an AFR for a sizeable enough part of those societies. Thus, although bearing a food-related function is not a necessary condition for being food, it is a relatively reliable indicator that the bearer bears an AFR and thus is food.

#### 4.5. Consequences of the social characterization of food

A consequence of this characterization is that drinks such as liquid water, fruit juice, beer or wine would be food. Although these are sometimes excluded from the category of “food”, this seems to be motivated by considerations of traditional usage rather than justified by ontological considerations.

Another question concerns the status of tobacco or cannabis products. One might want to restrict food to products that can be ingested rather than smoked – this is why the definition of AFR specifies “consumption *by ingestion*”. But what about chewing tobacco or edible cannabis products? Their status as food would depend on whether there is a community that sees them as acceptable for consumption to provide pleasant taste sensations (independently of them being consumed for psychoactive effects). And indeed, chewing tobacco in this sense would not be fundamentally different from chewing-gum. In that case, chewing tobacco and cannabis edibles might be seen as food products even if they have a psychoactive effect, like alcohol.

Conversely, if some alcohol with a bland taste is only considered for consumption for its psychoactive effects (and neither for palatability nor for nutritiveness), then it arguably is a drug rather than a food product – as it bears no AFR.

### 5. Comparison with definitions in existing ontologies

In light of what was written above on realizable entities, let us critically assess several definitions of related notions defined in existing ontologies.

We already critically assessed PATO’s definition of edibility. It also encompasses two subclasses: *PATO:Edible* and *PATO:Inedible*. *PATO:Edible* is defined as “A physical quality inhering in a bearer by virtue of the bearer being suitable for use as food.” However, as we argued, many non-food items are edible, thus this definition seems to characterize only a subclass of food.

ONS (the Ontology for Nutritional Studies) classifies *Palatability* of a food under *Information Content Entity* and defines it as “its capacity of triggering a reward (i.e. hedonic reward, or pleasure, via a stimulation of the dopamine reward pathway) upon consumption.” This

definition is problematic in several respects. First, it wrongly classifies *Palatability* as an information content entity. Second, it restricts palatability to food – although, as we saw, other items, such as drugs, might be palatable. NCIT defined *Palatability* as “The property of being agreeable to the palate or taste.” This definition is closer to ours, although it restricts palatability to taste matters, ignoring aroma, touch and other sensations.

The Compositional Dietary Nutrition Ontology defined *Nutritional Functional Attribute* as follows: “A functional attribute that inheres in one or more dietary nutritional component (or food material) and may contribute to a dietary role.” However, we could not find any definition of “dietary nutritional component” in the ontology. Also, material entities that are arguably not food (such as one’s pet or human flesh) might be nutritive.

Let us come back to CHEBI’s definition of *Food Role*  $DEF_{FR}$ . First, CHEBI classifies *Food Role* as a “physiological” role, which is itself classified as a subclass of *Biological Role*, which is defined as “A role played by the molecular entity or part thereof within a biological context”. However, we want to attribute food roles to entities larger than molecules, such as an apple or a cake. Second,  $DEF_{FR}$  mentions “nutrients that can be ingested by an organism”, without specifying which kind of organism. As we saw, we need to specify a group such as a species, and account for individual allergies or intolerance. Third, CHEBI states that a food role is a physiological role played by “any substance of either plant, animal or artificial origin”. However, this excludes mineral (e.g., salt) and fungi.

## 6. Discussion

### 6.1. Comparison with definitions of food by Borghini and Piras

Borghini and Piras [3] identify three other possible definitions of food beyond the physical view mentioned in the introduction. In particular, they introduce the *social* view of food, according to which  $x$  is a food iff it is socially recognized as such. However, this definition is circular (the “such” referring to the definiendum “food” in the definiens). Our formulation of food in terms of AFR avoids circularity, while arguably capturing the spirit of the definition by Borghini and Piras. Another view introduced by Borghini and Piras is the *authority* view of food, according to which  $x$  is a food iff it obeys the norms stated by the right authority; the view we proposed above is arguably more general, as it is not necessarily some “authority” that defines the role, but any community of agents. Thus, in our view, some materials can be (say) food-for-the-Baker-family (and carry an appropriate food role in this respect) without the Baker family being an authority on what is food.

### 6.2. Roles and extrinsic dispositions

Kaplan [1] discusses the tension between “food realism”, according to which food really exists “out there” in the world, “independent of our minds”, and the relational character of food. Our view solves this tension by arguing that entities that can become food materials do indeed exist independently of our minds, but they start instantiating the class *Food material* only when a community assigns to it an AFR. Accordingly, Borghini & Piras [3] observe that “we could claim that every predicate-schema ‘To Be an X-Food’ rests on a relevant social structure”. Further analysis of social roles will be necessary [16–18].

Note also that edibility, nutritiveness and palatability are defined relative to a *typical* organism, which itself depends upon the class or group it is typical of. If we consider groups whose physiology might change, then these dispositions might themselves change and thus be extrinsic [10,19] rather than *bona fide* BFO:dispositions, which are intrinsic.

## 7. Conclusion

Edibility, nutritiveness and palatability are three dispositions often found in food materials which are conceptually independent from each other; none of them is necessary or sufficient to food status though. Rather, we argue that food materials are defined by an appropriate food role. Although food items exist independently of any agent, their status as food depends on a community that recognizes it as appropriate for consumption by ingestion in order to fulfill nutritional needs and/or to provide organoleptic experiences.

The analysis of edibility should be completed by the various ways in which an item can be inedible. Future work should define special food (e.g. what is mayonnaise [1]) - an important question at a time when political decisions on these questions may be heavily influenced by lobbying rather than reasoned discussion (consider the French ban of labels such as ‘steak’ or ‘escalope’ on vegetarian products of February 27, 2024). In particular, ontology could help distinguish legislative vs. more common vocabulary usages.

As argued by Borghini & Piras [11], the clarification of the nature of food will help answering their “Duration Question (DQ)”, namely when an item ceases to be a certain type of food, which will contribute to enriching the temporal representation of food in FoodOn.

In the long run, we plan to connect our realizable-based approach to food with an ontology of recipes, which count as a typical example of directive information entities [20]; as well as to the ontology of artifacts — so that we will be able to develop a solid foundation for a comprehensive ontology of food products.

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