Space Food in the Media

On the Multisensory Design and Marketing of Food in Space

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Abstract *There are a number of deadly-serious issues around the provision of food and astronauts' consumption behaviour when considering the planned long-haul mission to Mars. One major concern relates to the phenomenon of 'space anorexia', where astronauts, as they typically do, fail to consume the recommended daily food/nutrition intake while in space. It has been suggested that a lack of multisensory appeal may be one of the key problems for the design of space food currently. At the same time, there are also more mundane questions about the catering on board for those ultra-high net-worth individuals who will be amongst the first wave of space tourists. Considering how to make space food more multisensorially desirable, as well as making the experience of eating and drinking in space (more) enjoyable has, over the years, stimulated the creativity of a number of designers, gastrophysicists, and star chefs. However, despite the various issues and challenges, the majority of the food 'research' that the public is likely to have come across in the popular press in recent decades can be seen as nothing more than merely expensive brand marketing, sometimes dressed up as 'scientific research'. From the very earliest days of manned space flight, it has been clear just how successful a marketing proposition it was for food brands to be linked to astronauts and space travel. That such marketing efforts should have proved so effective is, though, somewhat surprising given the traditionally poor reputation of space food, in terms of its lack of multisensory appeal, amongst astronauts.*

1. Introduction

There are a number of challenges around the provision of food for the planned long-haul mission to Mars (Cooper et al. 2011; Marriot 1999; Roach 2011). One of the most worrying relates to the phenomenon of 'space anorexia'. This is the name given to the fact that astronauts typically fail to consume the recommended daily intake of food/nutrients while in space (see Smith et al. 2015a, b). Indeed, anorexia was already being flagged as an issue of concern on the original Apollo XI mission (Smith/Berry 1969). While such undernutrition has little impact on an astronaut's health

when considering short space trips, its impact on ultra-long distance space travel (e.g. to Mars) could potentially be catastrophic. At the same time, however, there are also questions about the catering on board for those ultra-high net-worth members of the public who will be amongst the first wave of space tourists (Obrist et al. 2019). Considering how to make space food desirable, as well as the experience of eating and drinking enjoyable has, over the years, stimulated a number of designers (cf. Horwitz 2004; Obrist et al. 2019)[1], gastrophysicists (Spence 2017b), and star chefs to consider (more or less speculatively) what the future of food and beverage consumption in space might be/taste like.

The emerging science of gastrophysics offers a number of concrete suggestions as to how the multisensory experience of eating and drinking can be enhanced by the multisensory design of both food and drink, but also by the contexts/environments in which consumption takes place. Gastrophysics, a neologism represents the combination of 'gastronomy' and 'psychophysics' (the latter the systematic study of human perception), describes a relatively recent approach to the study of food choice, and food perception in humans (Spence 2017a). In contrast to more traditional approaches to food science, where the focus tends to be on the physicochemical structure and shelf stability of foods, the scientific focus in the case of gastrophysics is very much centered on psychological sciences (including psychophysics, cognitive neuroscience, behavioural economics, anthropology, design, etc.; Velasco et al. 2021). While much of the recent popularization of gastrophysics research has occurred in the context of the gastronomic creations of the world's most innovative chefs, it is worth noting that the optimizing of food, and food experience design is increasingly been taken up by the food industry both on the ground and in the air (see Spence 2017d).

However, despite the fundamental issues, not to mention challenges (physiological, nutritional, and technical) associated with the design and construction of desirable eating experiences for those who find themselves hungry in space (see Grampp in this volume; Gupta/Gupta 2010; Preston 2015), the majority of the food 'research' that has appeared in the popular press in recent years turns out to be little more than expensive marketing.[2] Indeed, from the very earliest days of space travel, it was apparent just how successful a marketing strategy it was to link food brands to astronauts and space travel (Blitz 2017). Nowadays, it often seems as though the majority

1 For instance, in the very early days of space flight, the father of industrial design, Raymond Loewy developed face-to-face trays for dining in space (cf. Horwitz 2004). This can be seen as a prescient recognition of role of eating together (commensality) as an important element in ensuring team building (see Salas et al. 2015).

2 The US restaurant chain Pizza Hut paid the Russian space agency a purported $1million to send one of their pizza deliveries up to Yuri Usachov, one of the Russian cosmonauts on the ISS as a promotional stunt (Anonymous 2001).

of the coverage in the popular press around space food has marketing very much in mind. At the same time, however, one of the other popular tools in the successful marketer's portfolio is product placement (e.g. in movies; Doolin 2016). Somewhat surprisingly, however, there is a noticeable absence of branded food products in space movies, perhaps reflecting the notable absence of food/eating in this particular genre of film.

This narrative historical review highlights some of the key elements in the history of research on food in space, focusing, in particular, on the interface between nutrition science, gastrophysics (Spence 2017a), design (Obrist et al. 2019), marketing, and media studies (Kauffman 1994). The enhanced multisensory design of eating experiences for the peculiarities of the space environment will also be discussed. One of the key points to be highlighted here concerns the marked discrepancy between the seeming lack of multisensory appeal of actual food/eating experiences for those astronauts who find themselves eating and drinking in space (Spence 2017b), and the popular portrayal of, not to mention the striking marketing opportunities for, those food brands that somehow manage to associate themselves with space ('research'). The terrible food provided to the astronauts in the early days is unambiguously brought out by the following quote:

> These space foods contain the necessary nutritional, vitamin, and caloric content to sustain an astronaut during long periods of space travel. Since some of the ingredients have a relatively offensive odor, taste, and texture when condensed in a small total volume of the food product, flavorings such as chocolate or vanilla may be added in an attempt to make the product more acceptable. (Wolfson/Oshinsky 1966: 21)

2. Using Gastrophysics to Tackle the Problem of Space Anorexia

Space anorexia is a potentially serious problem for long-haul space flight (e.g. Smith/Berry 1969; Smith et al. 2015a, b). Based on data from various space flights/missions over the decades, it has been repeatedly documented that astronauts consume only 60–90% of their daily recommended intake (e.g. according to World Health Organization, WHO, guidelines). The consequence of this underconsumption is a 4% reduction in body mass that is observable within the first 30 days in space, which then stabilizes amongst those spending periods of up to 6-months in space. Given that the meals prepared are carefully designed by nutritionists to provide an optimal diet for the astronauts concerned, such findings are especially worrying, when contemplating the long-term mission to Mars, currently scheduled for 2035 (O'Callaghan 2014). The Mars mission will take an estimated 32 months to complete and, as one headline put it: "NASA can't send humans to Mars

until it gets the food right." (Reynolds 2018; see also Perchonok et al. 2012) The cost and practical difficulties associated with having to lift an estimated 12,400 kg of dried food into space for a successful mission to Mars should not be underestimated either. Indeed, the latter concern has led to an interest in the possibility of growing fresh produce in space (i.e., to supplement the rehydrated freeze-dried items; cf. Finetto et al. 2010; Neilson et al. 2021; Preston 2015).[3] This should also help to tackle one of the most commonly-voiced complaints amongst astronauts concerning their space provisions, namely the lack of freshness (Masters 2012), or crunch (see Taylor et al. 2020 for a review).

Space food has been evolving ever since the Soviet cosmonaut, German Titov, became the first person to eat in space in August 1961. According to Miller (2018), it was Yuri Gagarin, who first ate in space (from tubes of pureed meat and chocolate sauce in 1961). The first North American to consume food (applesauce) on the third manned Mercury mission (in August 1962) was John Glenn (Perchonok/Bourland 2002: 913). Looking back over early space meals, it is easy to understand why the astronauts may have lost weight.[4] Shown below is a sample space menu illustrating what the astronauts would have been given to choose between eating during the Apollo missions to the moon:

> *Meal A:* Peaches (R), Bacon Squares (IMB), Cinnamon Bread Toast Cubes (DB), Breakfast Drink (R)
> *Meal B:* Corn Chowder (R), Chicken Sandwiches (DB), Coconut Cubes (DB), Sugar Cookie Cubes (DB), Cocoa (R)
> *Meal C:* Beef and Gravy (R), Brownies (IMB), Chocolate Pudding (R), Pineapple-Grapefruit Drink (R)
> *Abbreviation Key:* R= Rehydratable; DB= Dry bite; IMB= Intermediate Moisture Bite (Bourland/Vogt 2010: 13)

As Space.com put it: "Along with the hazards of space travel, early astronauts proved their bravery again during meal times" (see Belasco 2006; cf. Perchonok/Bourland 2002: 913). The food industry (e.g. Pillsbury) were involved in developing the earliest food to go into space. NASA astronaut, Scott Carpenter, went into space on the Mercury capsule Aurora 7 back in 1962, carrying the first solid space food, small cubes of

3 Along similar lines, Chinese space scientists have been considering the possibility of feeding their astronauts mealworms, given their high protein ratio (Tong et al. 2011)

4 According to Levi (2010: 6): "While one of the early US criteria for food selection was, reassuringly, that it should be 'liked by astronauts', some technologists did not pay much attention to their feedback."

food that had been developed by Pillsbury's research and development department.[5] Taking Pillsbury scientists more than a year to develop, space food cubes were followed by other space-friendly foods, such as cake that was not crumbly, relish that could be served in slices, and meat that did not need to be refrigerated (see fig. 1 for an example of a NASA space meal from 2003).

Fig. 1: Bags of International Space Station food and utensils on tray from NASA in 2003.

Source: https://www.nasa.gov/audience/formedia/presskits/spacefood/gallery_jsc2003e63872.html.

Over the last half century or so, researchers have been working on the question of how to make the food offering in space more appealing, increasingly turning to the emerging field of gastrophysics (see Kerwin/Seddon 2002, for an early suggested shift in emphasis from a focus solely on what is nutritious, but on foods designed for the limitations of the astronauts' taste buds; Spence 2017a, b) – e.g., going beyond the molecular gastronomy and food science of the physicochemical structure of the food itself, to thinking about the multisensory eating experience, and how it might

5 That said, the strawberry cubes were apparently so unpopular with the astronauts on the early Apollo missions that eventually they were dipped in Lucite and sold as souvenirs to space tourists back in Houston (see Crumpacker, 2006, pp. 114–115).

be affected by various food-extrinsic factors such as naming/description (Wolfson/Oshinsky, 1966), visual appearance (see Smith/Berry 1969 for an early suggestion that this might affect appetite), cutlery and plateware (see American Physical Society's Division of Fluid Dynamics 2015; see also Belasco 2006; Bourland/Vogt 2010), eating in company[6], atmosphere/environment while eating (cf. Neilson et al. 2021), etc. (see also Obrist et al. 2019).

There are a number of atmospheric factors that likely exert a detrimental influence over the astronauts' enjoyment of food in space, including the presence of various volatile organic chemicals (VOCs) in the atmosphere (i.e., the olfactory environment is malodourous, specifically sulphurous; Garber 2012), the background noise (c. 60dB, as compared to 80–85 dB in commercial air flight) which may suppress taste perception, and the lack of orthonasally-appreciated aromas, etc. (see Taylor et al. 2019; Taylor et al. 2020). The design and layout of the dining spaces themselves also likely play an important role (see Anderson 2004; Horwitz 2004; Spence 2017), as do postural considerations (Biswas et al. 2019). Nevertheless, in recent years, designers have come up with a number of potential solutions to various of these issues (see Obrist et al. 2019). A number of these have been inspired by, or at the very least build on, the emerging science of gastrophysics.

However, while things have undoubtedly improved as far as the provision of tasty food is concerned over recent years (see Lane et al. 2006; Lane/Schoeller 2000; Perchonok/Bourland 2002: 913), the fact that the problem of undernutrition (space anorexia) has still not been satisfactorily resolved, suggests that something is still fundamentally not right with the provision of food in space (Kerwin/Seddon 2002; Taylor et al. 2020). Intriguingly, the results of the four-month mock space mission in Hawaii highlighted the beneficial effects on food/eating of allowing the astronauts to engage their creativity as far as meal creation was concerned, rather than necessarily having all dishes entirely pre-prepared, which would presumably seem more efficient (e.g. Hunter et al. 2011; Isaacson 2013; Wall 2013). Nevertheless, given the lack of appeal of so much of the food that astronauts have been offered in space, it is perhaps surprising that so many of the world's largest food and beverage brands should have chosen to associate themselves so enthusiastically with the world of manned space flight.

6 Unfortunately, the time delay with communications back on planet Earth means that any attempt to establish 'digital commensality' with loved ones is unlikely to be feasible for longer trips (e.g., to Mars, see Spence et al. 2019; and see Reynolds 2018 on the importance of the social aspects of eating together in space).

2.1 Self-Promotion for the Star Chef's Brand: 3D-Printed Space Pizza, anyone?

Although never a serious possibility, the suggestion by North American star chef, Homaru Cantu, that astronauts would soon be eating 3D-printed pizza in space (Jayakumar 2013; Klotz 2013) garnered huge amounts of press coverage a decade ago (much of it incredulous it should be said). In fact, a closer reading of the evidence reveals that funding was only ever offered for Stage 1 research (see https://www.nasa.gov/directorates/spacetech/home/feature_3d_food.html#.V18jf-Z96Rs). Chef Cantu's proposal involved developing a food 'replicator', a converted ink-jet printer that was already producing 'tasty prints' for the guests in one of his restaurants (see Furness 2016 for the subsequent evolution of this pizza-printing technology). Having already conquered the skies with their tie-ins with various airlines (see Spence 2017a, d), several celebrity chefs have recognized the opportunity for self-promotion offered by collaborating with scientists in the design of space foods. The list includes the sadly-deceased Homaru Cantu (see above), Alain Ducasse (with 28 Michelin stars to his name) and Thierry Marx, with the highlight of their culinary endeavours apparently being a meal of 'beef tongue with truffled foie gras and duck breast confit' (see Anonymous 2016; Hughes 2015). Meanwhile, over in the UK, former world-leading chef, Heston Blumenthal (and his culinary research team), generated a huge amount of media interest when they lent their hands to developing space meals for the UK's first fully-British astronaut Major Tim Peake (see Green 2015). In this case, Blumenthal came up with dishes such as Nova Tiffin Capsule, Rocket Lolly, and the Big Breakfast Launch. With a nod to the emerging literature on gastrophysics, Blumenthal and his team also emphasized the importance of having a tablecloth (see Spence 2017a).

2.2 Catering for Space Tourists

The challenges facing those who have been tasked with catering to space tourists, when this sector really takes off (e.g. Crouch et al. 2009; Stockmans et al. 1995; see also Virgin Galactic: http://www.virgingalactic.com/; and the collaboration between Grey Goose vodka and Virgin Galactic on the theme of space cocktails; or Champagne House Mumm's work on drinking bubbly in space; Miller 2018)[7], may well be

7 Miller (2018) writes that: "This week, France's national space agency, CNES, will test whether a specially engineered bottle and glass are able to recreate that uniquely Earthly delight of popping some bubbly during a parabolic flight of a converted Airbus A310. The French champagne maker Mumm is behind the stunt, along with a Paris-based design firm called Spade. The zero-g test will be conducted in the skies above France's Champagne region and generate 22 seconds of weightlessness, during which the passengers will test Spade's new bottle."

that many people tend to feel sick on first entering space (due to the lack of gravity and unusual G forces; see Levi 2010; Olabi et al. 2002; Smith/Berry 1969). Separately, the reduction in gravity also means that more blood flows to the head and this has been reported to lead to a constriction of the diameter, and possibly even to a blocking, of the nasal passages (Kloeris 2001; Olabi et al. 2002; cf. Taylor et al. 2020). This is likely to have an especially detrimental impact on taste/flavour perception in space, given the often-cited claim that 75–95% of what we think we taste actually comes from the sense of smell (e.g. Lane et al. 2006; see Spence 2015 for a review). Intriguingly, Smith and Berry (1969) highlighted the lack of aroma (i.e., orthonasal olfaction) of foods that had to be sucked through straws as a likely concern when it came to the multisensory enjoyment of food more than half a century ago. New methods of drinking, involving the recently-invented space mug would also appear to have been greeted enthusiastically by a number of the astronauts (see Stanton/Spencer 2015).

3. On the Benefits of Food Marketing in Space

Ever since the earliest days of manned space flight, the food marketers were quick to recognize the phenomenal benefits for branding of being linked in some way to astronauts/space travel. Writing in *The New York Times*, Sang-Hun (2008) notes how the food companies have invested heavily in advertising, by putting their food brands into space. First off of the blocks in terms of capitalizing on the popularity of the space program was Pillsbury with their peanut butter space food sticks.[8] Thereafter, perhaps the most famous example was the powdered soft drink Tang. Although Tang was not invented with astronauts in mind, it became a popular hit amongst North American astronauts as one of the only things they liked, given the unpleasant taste of the water on board (e.g., as in the case of North American astronaut John Glenn in 1962, see Blitz 2017). The publicity surrounding this case led to a huge increase in sales.[9] In the 1970s, so-called Space Dust, a hugely popular sachet of brightly-coloured popping candy for kids, was launched into the market (Rudolph 2006).[10] The latter, note, being linked to space in name only. Nevertheless, the approach made

8 Though Space Food Sticks were successfully commercialized, they were subsequently withdrawn from sale. That being said, a cannabis-infused version has recently reappeared in the US for those wanting to 'release their inner astronaut' (see https://www.spacefoodsticks.com/).

9 However, after an unfortunate incident with a helmet full of Tang during the lunar landing, astronauts were only allowed to drink water subsequently (see Preston 2015).

10 As a young child in the 1970s, your author remembers Space Dust with great fondness. Intriguingly, the North American food scientist William Mitchell of the General Foods Corporation was responsible for inventing both Tang Flavor crystals and Pop Rocks.

perfect sense given the findings of research by Wolfson and Oshinsky (1966), published a few years earlier, demonstrated that simply associating a food product with space can make it taste better to the general public.

In a study published in the *Journal of Advertising Research*, Wolfson and Oshinsky (1966) gave their participants a commercially available chocolate milk and/or a chocolate-flavoured liquid space diet drink. These drinks could either be identified as 'space food' or as 'unknown'. When participants tasted each of the drinks once, changing the name was found to significantly alter their ratings. In particular, the drink labelled as 'space food' was rated an average of two points higher (on a 9-point preference rating scale) than the drink labelled as 'unknown'. Wolfson and Oshinsky went on to conclude that: "Altering the name of a food product to something related to the exotic would enhance the preference rating for the product" (1966: 23).[11]

Taking a closer look at the various press stories that have emerged in recent years, the pattern that emerges is that when an astronaut from a particular country is planning to go into space (e.g., to the International Space Station, ISS), then a brand associated with a typical/iconic food from that country will step forward, to dream up some 'research' with the said product: Think kimchi when the first Korean astronaut went into space (Song et al. 2009),[12] and espresso and lasagne (though presumably not at the same time) when an Italian went into space (American Physical Society's Division of Fluid Dynamics 2015; Associated Press & McLaughlin 2015; DesignBoom 2014).[13]

Of course, not all of the food and drink that makes its way into (or close to) space is necessarily destined for the astronauts themselves. Ardbeg whisky launched some unmatured malt whisky (Daily Mail Reporter 2015; though see also Hongo 2015 for the equivalent Japanese whiskey space research).[14] It is striking how such 'research' often nebulously talks about the importance of the findings, namely, in the case just-

11 It is, though, worth noting that no such naming effects were reported when participants were presented with the same drink twice.

12 According to one scientist working for the Korea Food Research Institute: "If a Korean goes to space, kimchi must go there, too" (Sang-Hun 2008). Sang-Hun (2008) also notes how: "After millions of dollars and years of research, South Korean scientists successfully engineered kimchi and nine other Korean recipes fit for space travel. When the Russian space authorities this month approved them for Ko's trip, the South Korean food companies that participated in the research took out full-page newspaper ads."

13 The coffee drinking experience is presumably far less enjoyable when the drink has to be consumed from a plastic pouch with a straw. The lucky Italian astronaut Samantha Cristoforetti also apparently had a slow-food chef making lasagne designed so as not to fly off the fork for her trip on the ISS (Callaghan 2014).

14 Talking of which, see also the haggis that was launched up to the edge of space before returning to Earth for Burns Night in 2021 (see Best 2021).

mentioned, how the whisky tastes different to a 'nose'. According to Dr Bill Lumsden, of Ardbeg Distillery, the company responsible for sending the spirit into space: "They reveal a different set of smoky flavours which I have not encountered here on earth before." (quoted in Daily Mail Reporter 2015). In this case, the aim of the 'research' was apparently to find out how micro-gravity affects the behaviour of terpenes, which are found in many food and spirits (see also https://www.ardbeg.com/ardbeg-events/Archive/Ardbeg-in-space).[15]

It is, though, unclear from these press reports as to whether the whisky was tasted blind, as would obviously be desirable for any proper research, nor whether the approach has sufficient power to detect any differences between samples. Bear in mind here only how the tasting of wine and spirits is subject to all manner of biases (see Spence 2010) and demand characteristics (see Orne 1962). One can easily imagine how the noses would have to come up with something to justify the expense, and deliver the media-friendly headlines and soundbites such as that "Whisky blasted into space as part of an experiment has returned with flavour literally out of this world, says its creator" (a quote that appeared in Daily Mail Reporter 2015). In fact, it would often seem as though the press headlines are more important than the findings of the 'research' itself.

From a media studies perspective, this discussion of food marketing raises the question of the various ways in which the relation to space is represented in media communications. While verbal cues have undoubtedly been used in some cases (think Space Dust), there is also a visual language that seemingly tries to represent the exotic or futuristic character of the food, by association (or transference) from the visual backdrop against which it is presented (see fig. 2). According to restaurant critic William Sitwell: "One finds excitement around food and space also playing out down on earth, as when Genroku Sushi opened in 1958: Having summoned the local press to his reopening, he announced: 'My plates of sushi circle the room like satellites in the sky.' Shiraishi used the language of the space age as he ushered journalists and customers into his establishment that day." (2020: 164)[16]

One other aspect of the press stories connecting foods to space emphasizes the more emotional (i.e., rather that the technical/nutritional) side of food. While, in the early days of space flight, little attention was paid to the palatability of space food (in part given the relatively short duration of the missions), in more recent years, a greater emphasis has been paid to the multisensory qualities of the food itself. While this is, in part, due to negative comments about some of the earlier food, there would

15 The Japanese brewing and distilling company Suntory also sent six samples of its whiskies and other alcoholic beverages up to the ISS, where they were kept for a year to study the effect of zero gravity on aging (Hongo 2015).

16 It is interesting to note that the sushi moves at exactly 8 centimetres per second. Any slower would apparently be frustrating, any faster would be too frantic.

also appear to be a growing recognition of the central role of food/mealtimes play in maintaining social cohesion amongst those on-board, not to mention the delivery of luxury food items, such as 30g of black caviar (Parfitt 2015), to astronauts on the ISS, obviously play a primarily emotional, rather than nutritional, role. Similarly, one might consider the rehydrated Thanksgiving Turkey dinner with candied yams that was presented to the North American contingent (Reuters/Beall 2016; Weitering 2016), or the Christmas pudding delivered to the first 'fully British' astronaut Tim Peake (Wyke 2015), while they were on board the ISS, as once again prioritizing the emotional value of familiar foods/dishes.

Fig. 2: One of the dishes served by chef Jozef Youssef of Kitchen Theory to passengers who have booked a seat on one of Virgin Galactic's forthcoming space flights at a pre-flight Sensploration event held in Wyoming, 2022.

Source: https://kitchen-theory.com/.

In such cases, however, one might want to question whether it is the flavour *per se* that is connected with emotional well-being or rather the more ritualistic elements associated with preparing/consuming these foods that is key (see Spence 2021). In other words, one might worry that something is lost in translation (cf. Stano 2016) when, as on Apollo 8's 1968 Christmas Day meal, the unappetising-sounding "thermo-stabilised turkey, gravy and cranberry sauce" (Masters 2013) was served, requiring the astronauts to suck the pureed rehydrated foods out of plastic pouches. It is easy to imagine how the emotional connection/nostalgia element might be missing, when that seasonal dish has to be rehydrated and then sucked through a straw (cf. Lu et al. 2015; Miller 2018). The role of comfort foods (Spence

2017c; though see also Hoffman 2014) has also started to become more prominent. Indeed, there would appear to be a growing acknowledgement of food's ability to lift the spirits, again something that may be especially important as the duration of trips into space increase (Associated Press & McLaughlin 2015; Lane et al. 2006).

Given the direction of many of the food recommendations for space missions that have emerged in recent years, there are a couple of foods/ingredients that would seem to have an especially legitimate link to the provision of space food (and hence to the marketing of food in space) currently: Specifically, energy-dense food bars (MacDonald 2016) and those products with added spice. On the one hand, there has been interest in developing lightweight, yet energy dense, breakfast bars to help address the payload issue for long-distance space travel.[17] On the other hand, given the reported dampening of the taste buds in space, the recommendation to add spice/pungency is something that has been mentioned in recent years by a growing number of space nutritionists, star chefs, and gastrophysicists alike (e.g. Green 2015; Oberg 1981; Olabi et al. 2002; Spence 2017b). In fact, extra spice was added to the pizza that was sent up to ISS by Pizza Hut a little over two decades ago (see Anonymous 2001).[18]

3.1 Product Placement in Space Movies

Given the huge marketing appeal associated with connecting food/beverage brands with space travel and astronauts, one might have expected there to be examples of product placement in space movies (Doolin 2016). There is, however, a noticeable lack of food and eating in this genre of movie, perhaps explaining its absence. (One could ask, whether this lack of eating also has to do with the difficulties associated with trying to represent the 'newness' of the food, and/or any of the unique chemosensory properties it might possess, in a medium that is essentially audiovisual.) One of the few movies where space food makes a cinematic appearance is in Stanley Kubrick's *2001: A Space Odyssey* (Eddy 2015; Haden 2005; Ronsen 2007). Furthermore, what food there is in space movies, is rarely portrayed in a flattering light, typically being shown

17 According to press reports, the astronauts on NASA's planned long distance Orion mission around the far side of the moon were to be given a calorie-dense food bar for breakfast, with each bar containing 700–800 calories. The flavours on offer at the time included banana nut, orange cranberry, ginger vanilla, and barbecue nut (see Mathewson 2016). These breakfast bars were designed in order to deliver the energy that the astronauts would need at the start of their day, while at the same time minimizing the space/mass required to deliver all the nutrition that will needed in the small spacecraft for the duration of the astronauts' journey. Here, one might also consider the suggestion that breakfast constitutes the most important meal of the day (see Spence 2017e).

18 This just one small step toward addressing Bourland and Vogt's comment concerning the fact that: "*After all, when you are 250 million miles from Earth, you can't just send out for a pizza. If you don't have a pizza maker on board, it is best not to think about pizzas.*" (2010: 181)

as bland/disgusting. What is more, many of the historical fictional accounts of space foods (e.g., in series such as *The Jetsons*, actually involves a meal in a pill; see Spence/Piqueras-Fiszman 2014 on the early portrayal of space food in TV shows). Similarly, in the TV series *Lost in Space*, the characters swallowed protein pills designed to provide all of their daily nutrition. This idea, a meal in a pill, something that the astronauts themselves have resolutely refused to countenance (see Spence 2017a; Spence/Piqueras-Fiszman 2014).[19]

4. Conclusions

In conclusion, the history of research on the multisensory aspects of food in space represents a fascinating interface between nutrition science, design, marketing, and media studies.[20] In recent years, there has been growing interest in adopting a gastrophysics approach to the design of food experiences on the ground, in the air, and also in space (see Spence 2017a, b). One important aspect of the design of foods/food experiences that is made particularly salient by comparison with the experience of food in space is the importance of the multisensory appeal of the food itself (i.e., what it looks, smells, sounds, and tastes like, even how it is described/labelled), over-and-above the traditional focus solely on a food's nutritional properties. Space food research has also proved to be something of a brand-enhancing vehicle for the media-savvy star chef, some of whom have also incorporated insights around how to enhance the meal experience taken from the emerging gastrophysics literature (Spence 2017a). While space 'research' appears to be a very successful approach for many food brands, it is certainly not a cheap solution to getting one's brand into the popular press (Anonymous 2001). Nevertheless, many food and drinks brands around the world would appear to consider it a cost worth

19 In the science fiction genre one can find a range of dystopian suggestions concerning what food could be like in the future under the circumstances of an overpopulated and totally exploited and hostile to life planet Earth. For instance, humanity feeds (largely unknowingly) on cannibalism in *Soylent Green* (1973; see Spence/Piqueras-Fiszman 2014), while in *Blade Runner 2049* (2017) a couple of indefinable bars (possibly made from worms) are prettified with the help of a hologram (Cawley 2017). In *Star Trek* the Klingons love to eat "Gagh" which consists out of (living) serpent worms and seems to taste awful to humans (see https://intl.startrek.com/database_article/gagh).

20 There has always been careful management of image that fits with what one sees in food. Just take the following quote from Kauffman (1994): "Even so, both NASA and the press contrived to present the astronauts as embodiments of the leading virtues of American culture and this has continued from the 1950s to the new millennium. Both NASA officials and the astronauts themselves carefully molded and controlled their public images every bit as successfully as those of movie idols or rock music stars."

paying, at least while the public's fascination with space travel continues at its current enthusiastic levels.

At the same time, however, there is an intriguing discrepancy between the seeming lack of multisensory appeal of actual food/eating in space (possibly contributing to space anorexia) and the popular portrayal of space food as being in some way desirable (perhaps because it is portrayed, or popularly-seen, as providing a window into the 'techno-food' of the future). This has, on occasion, suppressed the appetite for media coverage of food brands that have made it into space. Consider here only the problem of 'wet burping' (see Kloeris 2001): This phenomenon, attributable to the lack of gravity in space, means that the experience of carbonated beverages is none too pleasant. This may perhaps help to explain why little mileage has been made of heavily-marketed beverages such as Coke and Pepsi making it into space.[21] Of course, over and above any nutritional issues associated with space travel, it is important to note that there may be a range of other health concerns that should also be considered, and which might, ultimately, outweigh, nutritional considerations (e.g. Borkhataria 2017; Brojakowska et al. 2022; Carbone 2022; Gabel et al. 2022; Prigg 2017; Zwart et al. 2013).

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21 Though, interestingly Mumm Champagne made no mention of wet burping when their sparkling wine was sampled on a zero-g flight (Miller 2018).

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