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Singapore media and novel foods: how new innovations and food categories are made and negotiated through mainstream and social media

Keri Matwick

School of Humanities, Nanyang Technological University, Singapore

ABSTRACT

Through a media discourse analysis, this study draws upon quantitative and qualitative data to gain insights into how new food categories are made and negotiated through mainstream and social media. The focus is on alternative proteins, a growing food sector largely driven by the current unsustainable industrial animal farming. Plant-based meats have long existed as alternative sources to meat, and insects have been historically eaten in parts of the world; yet, the crisis of climate change and increasing sophistication of technology have spurred the development of innovations like cultivated meat, microalgae, and fermentation protein. To better understand how food categories are redefined, this study focuses on Singapore media and its framing of these foods, considered novel here for their potential to revolutionize future food sources by how they are made and/or consumed. The contested views on the edibility and categorization of these novel foods signal resistance to Singapore's accelerated modernity.

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Introduction

Alternative proteins are a growing food sector largely driven by the current unsustainable animal farming industry and climate change crisis. Included in this category are plant-based meats, insects, microalgae, fermentation, and cultivated meats. While plant-based meats have been around for centuries (i.e. tofu, tempeh, seitan), and insects have historically been eaten in parts of the world, innovations of alternative proteins have been developed as replacements for conventional animal products. Cultivated meat, also known as cell-based, lab-grown, and cultured meat, has been revolutionary for its potential to alter food supply. Derived from animal cells, cultured meats are grown in a lab, effectively removing traditional livestock farming while retaining the same genetic make-up and taste as traditionally-made meat. Microalgae and fermentation have also become part of the alternative protein landscape. These various types of alternative proteins can be considered novel foods in how they are being discussed and framed in the media as food and as solutions to an environmentally threatened and food-insecure world (Abrell, 2023).

CONTACT Keri Matwick kerimatwick@gmail.com

The media has debated over novel foods and their potential positive and negative impacts at the economic, social, cultural, and environmental levels. The taste, cost, safety, and ethics of novel foods are among the discussions that are part of larger narratives that frame our understanding of how and what we eat (Eden, 2011; Sexton, Garnett, & Lorimer, 2019). As media express and shape attitudes and values (Bednarek & Caple, 2017; Cotter, 2010; Harcup, 2021), we can identify how novel foods are being positioned in the media, including framing, perception, receptivity, and categorization.

In Singapore, food security and sustainability have become national priorities given the island nation's vulnerability to global food shortages and limited natural resources as exacerbated by the pandemic. Currently, Singapore imports more than 90% of its food sources from more than 170 countries. To strengthen its food security, Singapore outlined a long-term vision, a '30 by 30' plan with the goal of producing 30% of its nutritional needs by 2030 ('30 by 30', 2023a). To carry this out, the Singapore Food Agency (SFA) is pursuing three Food Baskets: Diversify import sources, Grow local, and Grow overseas ('Our Singapore Food Story', 2023b). Unconventional spaces are being used for farming, e.g. rooftops, restaurant patches, and vertical farming. But more radical is Singapore's investment in making novel meat, cell-by-cell, and with a stamp of safety (Abdullah & Klein, 2023).

The first in the world to approve lab-grown meat for consumption in 2020 (Tan, 2020), Singapore sets precedence as an innovative food hub and pioneer in the space of novel foods. Global attention has continued to focus on this Southeast Asian nation as a model of safety guidelines and infrastructure (Begum, 2023). Yet, much less known is how Singapore media is communicating about novel foods. Even more, Singapore media is not like traditional media; largely state-owned, its flagship newspaper and most circulated platform, *The Straits Times*, can be used as a mouthpiece of the state. Even if food in the media is not a form of government intervention, this study follows the line of rising research that acknowledges food as political (Nestle, 2003; Wurgraft, 2020), a tool for national identity (Counihan, Van Esterik, & Julier, 2017), a technological product (Stevens, 2024; Stevens & Ruperti, 2022), and that the media plays a role in communicating institutional ideology and national values.

The paper will begin with an overview of the literature on alternative proteins within the field of language, communication, and media. The methodology of the study, including the data and analytical framework, is provided, followed by a presentation of the findings from both mainstream and social media on the categories of cultivated meat, plant-based protein, insect protein, fermentation, and microalgae. The discussion contextualizes the data analysis within the Singapore context so as to better understand the comments on what food is or should be. In this way, the study contributes to understanding of how novel foods are being negotiated and categorized as (in)edible. Findings in traditional vs social media signal a pushback from ordinary people to the rapid modernization and technologization of the state. While the state is breathless to assert its global reputation as a pioneer in food technology, among other industries (e.g. digital economy, digital society), its people are showing resistance and a revalorisation of traditional foods.

Literature review

Language and food

Language shapes perceptions and our understandings, including the way we describe novel foods. In a literature review on meat and milk alternative narratives, Lonkila and Kaljonen (2021) deliberately chose 'alternative' as a 'neutral denominator' in their search, describing it as a 'less divisive option than "substitute"' (p. 626). To use Sexton's (2016) term, the 'stuff' of meat and how we understand it is determined by both its 'materialities and imaginaries' (p. 66). In examining rhetoric in the media, we can examine the discourses attempting to give shape to these 'imaginaries' of novel food, including our beliefs and understandings of what 'meat' entails.

Metaphors and comparisons offer ways to understand new concepts like novel foods. Examining the discourse of the alternative protein sector, including cell-based meat, Broad (2020) identified two dominant conceptual metaphors: 'meat is made' and the 'market', which separate meat from its traditional connection to farming while highlighting the role of innovation and capital investment. Other marketing language used in the discourses of alternative protein was 'scaling up', 'disruptive changes', and 'incubators' (Broad, 2020, p. 927). Food is no longer just for consumption but a product, commodity, and symbol of technology and business.

Further, the language used to name a product affects consumer perceptions and consumption behavior. Comparing the perception of 'in-vitro' meat under different names, the term 'lab-grown meat' was found to evoke the most negative emotions (due to its association with artificiality and disgust), while 'animal-free meat' confused consumers who associated it with vegetarianism or veganism (Bryant & Barnett, 2019). On the other hand, 'cultured meat' was largely linked to science, while 'clean meat' evoked the most positive associations related to health, tastiness, or cleanness (Bryant & Barnett, 2019). Other research has similarly confirmed associations of novel meats with science, noting negative associations of artificiality with 'lab-grown meat' along with 'in vitro' and 'synthetic' (Reis, Heidemann, Borini, & Molento, 2020). When consumers perceive a product as 'high-tech', they are less likely to consume it (Bryant & Dillard, 2019; Chriki et al., 2021).

Using the word 'meat' itself has been found to be controversial in the marketing of cell-based meats (Chriki et al., 2021) with governments called on to create standards of labelling (FSIS, 2023). The lack of uniformity and consistency in terminology has been noted as an impediment to communicating with consumers. The non-profit think tank and promoter of alternative proteins, Good Food Institute (GFI) has called for industry-wide adoption of 'cultivated meat', drawing upon research that shows the term to be the most transparent and accurate terminology (Friedrich, 2019). Also, 'cultivated' aroused positive associations of meat with growing plants and agriculture ('GFI Fact Sheet', 2023). Helping people to understand novel food as 'growing meat' may help move meat further away from negative associations of slaughter and animal cruelty as well. The term 'cultivated' also evokes images of greenery and naturalness, distancing it from the sterileness of a research lab.

Studies of novel foods in traditional and social media

Research has examined the media coverage of novel foods, noting mixed reactions and unbalanced viewpoints. Providing an early overview of print articles on cultivated meat, Goodwin and Shoulders (2013) conducted a qualitative analysis of cultivated meat articles in the United States and the European Union. While the analysis showed more positive views of cultivated meat, the authors point to the minimal representation in the media from the perspective of the traditional animal industry. Moreover, the articles primarily detailed the benefits of cultivated meat production for the environment, animal welfare, food security, and human health (Goodwin & Shoulders, 2013). The predominantly positive view of cultured meat in the media coverage has similarly been correlated by other studies to the uneven representation of interested parties (Hopkins, 2015; Painter, Brennen, & Kristiansen, 2020).

Within this positive framing, media coverage has been identified to consist of 'promissory narratives', which describe what will happen (Sexton, Garnett, & Lorimer, 2019). With cultivated meat and a number of plant-based products still unavailable, narratives consist of promises of what these foods may bring: environmental sustainability, humane animal treatment, and food security (Dilworth & McGregor, 2015; Schaefer & Savulescu, 2014). Further, stakeholders and innovators offer arguments for 'better meat' rather than reducing meat (Bhöm, Ferrari, & Woll, 2018). This argument would appeal to the growing demand for meat, especially in the rising middle classes in Southeast Asia and China (ADM Capital Foundation, 2018), and in Singapore, a wealthy nation that already eats meat on a regular basis (SFA, 2022).

Social media conversations about novel foods offer important variations from print media. In a Twitter analysis, Specht, Rumble, and Buck (2020) discovered that the frequency of discussions about cultivated meat is news driven. Conversation spurts were linked to specific news stories, showing a lack of consistent and sustained conversation. Further, variations in terminology were identified, from 'lab-grown' and 'cell grown' to 'cultured meat' (Specht, Rumble, & Buck, 2020). However, certain terms appear to be gaining prominence over others. Another study found that the most used hashtags on Twitter for these products were #culturedmeat and #cultivatedmeat (Pilařová, Kvasničková Stanislavská, Pilař, Balcarová, & Pitrová, 2022). While there appears to be a convergence of terminology, the diverse associations and uses are being recognized as important considerations in the politics and practices of edibility.

As culture contributes to perceptions around food, studies have examined attitudes towards cultivated meat in specific countries. A cross-country investigation noted that Singaporeans are more accepting than Americans of lab-grown meat in general (Chong, Leung, & Lua, 2022). The researchers attribute the difference in acceptance level to social image eating motivations; for Singaporeans, the cultural traits of *kiasuism* or the fear of missing out (fomo) could motivate Singaporeans to be more accepting of frontier and innovative food technology compared to other countries. Another study on Singaporeans finds that individuals who had prior beliefs – environmental consciousness and health consciousness – were more likely to notice media messages on plant-based meats (Ho, Chuah, Koh, Ong, & Kwan, 2022). Further, the less familiar they are with novel foods, the more Singaporeans may rely on their perceptions of others' attitudes towards these foods in their willingness to consume it, and even more, have a greater willingness to pay more

for it (Ho, Chuah, Koh, Ong, & Kwan, 2022). Media portrayal may also impact perceptions of food and influence social norms, thus motivating further research on Singaporean's attitudes towards cultivated meat and other novel foods.

Building on this research on the communication of novel foods, this current study shares the results of a year-long study on the discourses of mainstream media and social media platforms of Singapore about novel foods.

Methodology

Data

English mainstream media and social media data of Singapore were collected in collaboration with the media intelligence company Truescope. Initial desk research led to a curated list of commonly recurring keywords relating to the five categories of novel foods under investigation: cultivated meat, plant-based protein, insect protein, fermentation, and microalgae.

This discovery process resulted in an extensive list of keywords for ingestion into Truescope's platform (see Table 1 for keywords). Included was a list of 253 companies involved in the manufacturing and production of various types of novel foods in the search parameters. This list of companies was obtained from the GFI Asia Pacific website[1] and was accurate as of February 2023.

Mainstream media channels include online and print sources, while social media channels include Facebook, Instagram, Twitter (X), and Forums (HardwareZone, Reddit, SG Talk). All channels on mainstream and social media were limited to Singapore-only channels.

The monitoring period was one year (1 July 2022–30 June 2023) with two reports published: 1 July 2022–31 December 2022 (H2 2022), and 1 January 2023–30 June 2023 (H1 2023). The reports were compared with data confirming initial findings. Data from both reports is presented here.

Data analysis – mainstream media

All mainstream media articles crawled by the Truescope app were then analyzed, using a process inspired by Braun and Clarke's (2006) approach to thematic analysis.

Table 1. Sample keywords of novel foods methodology.

Novel Food Category	Sample Keywords
Cultivated Meat	"Cultivated meat", "Cultured meat","Cell-based meat", "Cell-based protein", "Cell-culture meat", "Cell-culture protein", "Lab-grown meat", "Lab-grown protein"
Plant-Based Protein	"Plant-based meat", "Plant-based protein", "Plant-based seafood", "Plant-based egg", "Plant-based dairy", "Plant-based milk"
Insect Protein	"Insect-based meat", "Insect-based protein", "Insect-based food", "Edible insects", "Entomophagy", "Insectivory"
Fermentation	"Traditional fermentation", "Biomass fermentation", "Precision fermentation", "Microbial fermentation", "Mycoprotein"
Microalgae	"Microalgae", "Seaweed protein", "Spirulina", "Chlorella"

Specifically, the following method was used to organize and describe all available mainstream data:

- Reading the articles to search for underlying meanings
- Generating initial codes to identify semantic or latent content using a data-driven approach (i.e. eventual themes will solely be dependent on the data) and without limiting oneself to a specific number of codes to generate
- Searching for themes based on the list of codes that were generated – sorting and collating all the generated codes and considering how they may be combined to form an overarching theme
- Reviewing and refining of themes (e.g. collapsing multiple themes into a single theme or splitting a theme into multiple other themes)

Data analysis – social media

For each category of novel foods identified, a representative sample of comments (95% Confidence Level, 5% Margin of Error) was examined if the volume of comments exceeded 300. All comments were analysed if there were less than 300 comments for any particular category of novel foods (e.g. micro-algae-based foods).

The data analysis process (i.e. coding) is inspired by Charmaz's (2006) version of grounded theory.

- Initial coding – break down the users' comments line by line, pick up actual words and phrases, and assign codes to them. Particular attention was paid to signal out *in vivo* codes (participants' exact phrases), because it captured the essence of the meanings and experiences of what locals are saying.
- Focused coding – start to organise, synthesise, and categorise all the initial codes into concepts for interpretation.
- Throughout the entire process, a constant comparative method was applied to the data in order to synthesise the codes or break them off and find more applicable codes.
- This iterative and reflexive process was undertaken until there were no further emergent concepts (i.e. theoretical saturation is achieved).

To help discover these concepts, the following scrutiny worked well: (a) repetitions; (b) local expressions; (c) similarities and differences in how the same topic/issue is being discussed; and (d) analogies (Ryan & Bernard, 2003).

From both reports, the articles from the data search totalled 513 articles (traditional media) and 13,221 comments (social media) (Table 2).

As seen in Table 2, cultivated meat and plant-based protein discourse received the most volume across both traditional and social media. Insect protein and fermentation received some attention while micro-algae had the least overall. Notably, insect protein generated considerable social media activity in comparison to traditional media.

Table 2. Media coverage of Singapore media of novel foods.

	Article Count (Traditional)		Comment Count (Social)	
Category	H2 2022	H1 2023	H2 2022	H1 2023
Cultivated meat	84	110	1,311	5,967
Plant-based food	122	85	2,213	819
Insect protein	14	23	954	1,502
Fermentation	38	25	351	104
Microalgae-based food	1	11	0	0
Subtotal	**259**	**254**	**4,829**	**8,392**
Total (H2 + H1)	**513 Articles**		**13,221 Comments**	

Analysis

The top channels reporting on each category by traditional media and social media can be seen in Table 3: Media Reporting on Novel Foods: Coverage Overview. *The Straits Times* and *The Business Times* were the top traditional media contributors on the topic while social media comments came from various Instagram and Facebook accounts, including the social media accounts of traditional media channels.

Cultivated meat

The media on cultivated/cell-based/cultured food largely was driven by extensive coverage of two main companies: Eat Just, a US company that received approval from the Singapore Food Agency (SFA) to produce serum-free cultivated meat, and the Australian alternative protein start-up Vow and its (figuratively and literally) mammoth meatball. Within this category, traditional media prominently covered three main themes: 1) innovation and collaboration, 2) food resilience and food security, and 3) sustainability. In contrast, social media surfaced

Table 3. Media reporting on novel foods: coverage overview.

Coverage overview								
Category	Traditional media (Article volume + Net sentiment + Top channel)				Social media (Engagements + Net sentiment + Top channel)			
	Article Vol. (Net Sentiment)		Top Channel		Engagements (Net Sentiment)		Top Channel	
	H2 2022	H1 2023	H2 2022	H1 2023	H2 2022	H1 2023	H2 2022	H1 2023
Cell-based/cultured food	84 (+87%)	110 (+74%)	The Straits Times	The Straits Times	6,007 (-40%)	52,831 (-41%)	South China Morning Post Facebook	Reuters Instagram
Plant-based food	122 (+49%)	85 (+66%)	The Straits Times	The Business Times	12,806 (-27%)	6,583 (-29%)	nxtasha.ann Instagram	USA Today Instagram
Insect Protein	14 (+90%)	23 (+39%)	The Crowd Review	The Straits Times	10,508 (-22%)	11,654 (-24%)	straits_times Instagram	NBC News Instagram
Fermentation	38 (+72%)	25 (+74%)	The Straits Times	The Straits Times	3,372 (-34%)	806 (-50%)	melissackoh Instagram	The Straits Times Facebook
Microalgae-based food	1 (+100%)	11 (+100%)	Green Is The New Black	The Business Times	124 (0%)	51 (0%)	偷吃 Foodie King Facebook	Sage's Sea Moss Instagram

concerns about the long-term health and safety concerns of consumer cell-based foods.

Traditional media: innovation and collaboration, food resilience and food security, and sustainability of cell-based foods

Innovation and collaboration were common discourses in mainstream media about cultivated meat. News reports highlighted Vow's development of a giant meatball which included DNA of the extinct woolly mammoth (as well as elephant DNA and sheep stem cells). Other reports were on Umami Meats, a Singapore-based company making cultivated seafood, and their collaborative efforts with other firms to drive innovation in the cultivated food space. Several brands also received media coverage for receiving regulatory approval from the Singapore Food Agency (SFA) for the production or commercialization of cultivated meat in Singapore. These brands include US-based GOOD Meat and Israel's Aleph Meats.

Other innovations reported on: (i) Solein – a protein 'made from air' that received approval in Singapore; (ii) National University of Singapore (NUS) scientists and their novel use of magnetic pulses to grow cell-cultured pork; (iii) their development of a new edible ink which can be used to grow meat in laboratories in a more cost-effective way; and (iv) the opening of an alternative novel meat innovation centre in Singapore in the second half of 2023.

Food resilience was also a major theme reported on by traditional media. Major publications such as *The Straits Times* and *CNA* reported that the emerging alternative proteins market is helping Singapore's bid to become more food resilient. Some of the articles also cited SFA's 30 by 30 goal, which has triggered investment in the production of cell-based meats such as beef and chicken. In reports about Singapore investing S$165 million in a food security programme, DPM Heng Swee Keat said that alternative protein is a promising area to meet Singapore's food and nutrition needs in an urban environment. During the COP27 event in Egypt, Minister Grace Fu said that novel food is an area that has much potential to supplement Singapore's food security, but that cultivated meat products will take time to scale up and commercialise.

Traditional media reporting also focused on various companies' sustainability efforts: (i) alternative protein start-up Ants Innovate is aiming to produce more climate-friendly food such as pork dumplings and wontons made from cultured pig cells; and (ii) Nanyang Technological University (NTU) researchers and chicken producer Leong Hup spearheaded the conversion of biological waste such as chicken blood into an alternative medium for cultivating cell-based meat.

Further, traditional media reported on the science and technology of cell-based foods, such as an article by *The Straits Times* about how Aleph Farm makes its ribeye steak: 'the process involves the printing of living cells which are then incubated to grow, differentiate and interact, in order to acquire the texture and qualities of conventional steak' (Quek, 2021). There were attempts to communicate with the public what these processes mean to them by localizing the innovations to Singapore and Asia. In this same article, Aleph Farms chief executive Didier Toubia explains why beef was chosen as an 'entry point' into the cultivated meat industry, 'beef is not the most consumed meat in Asia, but the most premium one, and the fastest growing market' (Quek, 2021). While traditional media did not always translate complex science and technology jargon into simpler language, articles included how the innovations could relate to readers.

A few articles in traditional media noted challenges facing cultivated meat companies. One challenge is raising investments, given their long runway to commercial viability. Others are affordability and scalability, which were noted by the CEO of Avant Meats Carrie Chan. Further, a commentary in *The Straits Times* contended that high production costs and increasingly vegetarian appetites may prevent the lab-grown meat industry from taking off.

Social media: negative sentiment with concerns of the health and safety of cultivated meat

For social media, there was an overall negative sentiment towards the consumption and production of cultivated meat. While some expressed optimism ('it will be a game changer internationally') and noted ethical benefits ('Anything we can do to stop abusing animals is a step in the right direction'), most were disgusted at the prospect of having cell-based meat in their diet, describing it as 'fake' and 'Frankenstein food'.

Concern about long-term health and safety was also expressed about consuming cell-based foods. Some expressed that they felt that they as citizens of Singapore were 'guinea pigs' and 'lab rats' in testing the viability of consuming cell-based foods. Humorous yet sarcastic comments were given, such as 'WHAT? We are the only country selling them? Didn't know we signed up for clinical trial' and 'You vil eat ze lab grown meats and be nourished'.

Further, a few opined that the choice to consume cell-based meat should be the individual's choice, suggesting that there is pressure to approve it and incorporate it into one's diet. There was some discussion that the cost of cell-based foods would be the biggest barrier to widespread production and consumption, adding that they would not purchase cell-based food products if it was more expensive than other alternatives and traditional meat.

Plant-based food

The focus of media coverage within this category of plant-based food centred on perspectives from restaurants featuring plant-based cuisine, in addition to highlighting recent product launches and advancements in the field. A similar trend emerged on social media, where a significant portion of content revolved around reviews of plant-based items by influencers and lifestyle outlets. Yet, social media comments also expressed concern for the health of plant-based foods, noting that they are highly processed.

Traditional media: focus on products and consumer adoption of plant-based foods

Across traditional media, articles were predominantly interested in the taste and cost of plant-based foods and consumer receptivity and adoption. Featured were plant-based product reviews, coverage of the launch of different plant-based foods in the retail and food service industries, as well as several opinion pieces on consumers' reception towards plant-based foods. Listicles were noticeably popular, highlighting various restaurants in Singapore that offered plant-based dishes and meals.

Investments in plant-based foods also received considerable press coverage with reports on government initiatives and competitions. Main stories include a new 11,000 sq ft facility that opened in Tuas, an industrial area on the west coast of the island. The facility will allow firms to produce plant-based protein like meatless patties. Other features were of researchers from Nanyang Technological University

who hoped to commercialise their new type of protein made from fungi which is said to be nutritious. Other reports were of EnterpriseSG who partnered with leading venture accelerator Brinc to launch the Food Technology Program, a 12-week-long initiative that aims to support plant-based meat or dairy startups in their journey towards becoming commercially ready. The media also covered the DBS Foundation X NEA Hungry for Change Challenge, in which team VEME of NUS won for developing a flavor catalyst that will improve the look, smell, and taste of plant-based meats.

Social media: concerns of cost and health of plant-based foods

Overall social traction was high on plant-based foods with discussion in various mainstream media outlets' and influencers' Facebook and/or Instagram pages (e.g. The Guardian, Yahoo, CNA, Bloomberg, The Straits Times Facebook and Instagram, Zoe Tay, Dawn Sim, Reddit Singapore Forum).

Commentators were largely critical of plant-based products, suggesting that they were highly processed and not necessarily healthy as claimed by many brands. For example, 'Price difference too is really *beyond* understanding and *impossible* to justify' (in reference to the plant-based products by *Beyond Meat* and *Impossible Burger)*; 'Good. It's called plant based because its made in a plant. A chemical plant'. This skepticism and concern for the naturalness of novel foods have been observed in other studies as well (Broad, 2020, Dilworth and McGregor, 2015; Goodwin & Shoulders, 2013).

A few noted that they would be unwilling to purchase plant-based meats if they cost more than existing foods, similar to the response expressed about cell-based food.

Insect protein

In contrast to cell-based and plant-based categories, the insect protein category received little traction across traditional media. Yet, it was a hotly discussed topic on social media. Peaks in overall media coverage were April 7–9, 2023, with SFA's (Singapore Food Agency) approval of the sale of insects for local food consumption.

Traditional media: insects safe for consumption and part of the food security plan

In mainstream media, the majority of the coverage for the insect protein category was driven by factual reports about SFA approving 16 species of insects (including crickets, silkworm, and grasshoppers) for human consumption. The reporting of insect consumption was framed around the sustainability and food security implications of consuming insects.

Before the announcement of this news of SFA's approval, several media outlets reported about how some food establishments in Singapore have been selling silkworm pupae illegally, and that SFA was investigating these eateries.

Reports also featured insect protein companies in Singapore, including (i) Entoverse, which delivers cutting-edge digital solutions for the insect farming sector; (ii) InnovaFeed, which has received investment from Singapore's Temasek; and (iii) Future Protein Solutions, which focused on cricket farming. All these articles framed the

consumption of insect proteins in a positive manner but also noted the challenges when it comes to gaining consumer acceptance. Further, several articles noted that industry players remain divided on the scale of consumer demand for insect protein in Singapore.

Social media: criticism and disgust towards insect consumption

The novel concept triggered commenters' reactions – many were critical of insects as a food source, while some shared their own experiences consuming insects, and others discussed whether insects were safe to consume. Discussions primarily occurred on CNA and The Independent Facebook pages, Reddit Singapore Forum, Mothership.sg, and HardwareZone forum. These were primarily about the illegal sale of insects at restaurants in Singapore and the pending approval of the sale and consumption of 16 insect species in Singapore.

Other discussions on social media focused on the discourse of insect consumption. Some asked if insects were halal, reflecting a concern of Singapore's Muslim community. Some noted that insect consumption was common overseas. A few claimed that with high inflation and potential food supply disruptions, the public would have to turn to insects. Overall, the majority expressed disgust towards consuming insects with some suggesting that supporters eat cockroaches. Some were concerned with the health and safety of insect consumption. A few pitched the discourse of insect consumption as a divide between the elites and commoners.

Fermentation

A relatively new category for cell-based protein is the use of fermentation to cultivate animal and plant cells. Traditional media reported on the innovation and investment of fermentation with articles typically expanding on the technologies used to create the products. Social media expressed scepticism and doubt that food from fermented technology would become a substantial part of one's diet.

Traditional media: fermentation as innovative

Across traditional media, news on the fermentation category mainly consisted of innovative launches within the space. These include (i) mycelium protein company Mycovation launching a fermented mix that can enhance the texture and flavor of alternative protein; (ii) TurtleTree announcing the production of LF+ - the world's first sustainable bovine lactoferrin created using precision fermentation technology; (iii) the launch of Very Dairy – Asia's first dairy milk produced entirely without animals, developed using a proprietary precision fermentation technology, (iv) the launch of Perfect Day's animal-free dairy which is made with precision fermentation technology; and (v) the global debut of Solein, which is billed as the world's most sustainable, farm-free protein. The headline, 'Singapore first to approve protein "made from air"', emphasizes Singapore as a forerunner in producing the growing microbial fermentation trend.

Social media: skepticism in "eating air"

Social media expressed familiarity and understanding of the mainstream articles on fermented proteins, specifically with comments mirroring the mainstream article on Solein, i.e. 'humans would soon be "eating air".' In contrast to traditional media,

commenters were more openly dismissive of the product. The negative sentiment was highest overall in this category of novel foods (−34% in H2 2022; −50% in H1 2023).

Microalgae

Microalgae received the least overall media coverage. A notable spike was on 29 June 2023, when traditional media reported on vegan ice cream made from Sophie's BioNutrients' dairy-free Chlorella Protein Concentrate, a neutral-hued microalgae flour naturally cultivated from Chlorella vulgaris.

However, no chatter was observed on social media, suggesting that microalgae food products are still in the early stages of market development and consumer awareness.

Discussion

To understand the meanings and understanding of what food is or should be, we must consider these discourses within the context of Singapore. Historically, Singapore has been preoccupied with food as part of its national development and image (Tarulevicz, 2013). As a nation dependent on importing goods, yet also young and eager to prove itself to the world, Singapore has leveraged the technology of food as a tool for economic growth. As depicted by the traditional news sources reported in this study, novel foods would purportedly advance Singapore's food security plan. This rationality could be rooted in the government's guiding principle of pragmatism (Tan, 2012) and the historical use of food security as a platform for economic growth (Tarulevicz, 2013, p. 161).

As Tarulevicz (2013) keenly observes, the island nation's people and food culture are shaped by the government: 'the bodies of citizens have literal and figurative meaning for the Singaporean state and are sites in which national ideology can be sculpted, inscribed, and embodied' (p. 2). National ideology thus is inscribed in its people through what they eat, and in this case, Singaporeans eating novel foods embody Singapore as a modern, technologically advanced nation. Further, Stevens and Ruperti (2022) argue that novel foods are part of Singapore's vision of building a 'smart nation' with food policies and investments in place to accelerate the development of technology for novel foods. For this vision to be fully carried out, I would add that a shared belief of what counts as edible needs to be shared. This mutual understanding, as this analysis shows, is still being contested, negotiated, and re-established.

Specifically, this study illustrates that traditional and social media have contrasting sentiments and perspectives of novel foods. Institutional discourse is overwhelmingly positive in its topic choices and framing of novel foods, leaning into science and technology for evidence in its promotion of novel foods while popular discourse expresses concerns about safety, taste, and cost, using critical and sarcastic arguments based on personal experiences, values, and emotions. This suggests two key findings: 1) there's a disconnect between mainstream media language and portrayals and public perception, and 2) there's a feeling of being bullied by the state to accept (and eat) these novel foods.

In being an early adopter of novel foods, Singapore is framed in traditional media as a leader in a cutting-edge field of science and research. This also makes the impact appear more local and relevant to the people, perhaps encouraging more adoption and

receptivity to novel foods. Further, this projection of Singapore as 'trailblazers' through its cultivated meat venture is in line with Chong, Leung, and Lua (2022) whose conclusions associated locals' purported willingness to eat lab-grown meat to 'stand out from the crowd' and 'look good in front of others' (p. 4). While national ideology may influence its citizens' self-perceptions, this present study also shows another side that was not evident in previous studies: there is hesitancy, caution, and ultimately refusal to adopt these novel foods as shown in the social media comments.

Particularly, social media had negative sentiments towards cultivated meat and plant-based foods, with comments expressing anxiety over the unknown health effects, complaining about the high costs, and critiquing its unappetizing appearance and taste. As shown in the discourse about guinea pigs and being lab rats, sarcasm and skepticism were frequent, serving as ways to provide humour yet express concerns of being themselves test subjects of the state's experiment. This growing strand of resistance in Singapore can be seen in other rapid and modernising projects from the state, such as an unusually vocal campaign against the exhumation of a cemetery (Leow, 2012), and the petition to prevent the deforestation of Clementi and Dover Forests (Ng, 2021). Food is one of these domains; the push for heritage foods rather than industrially produced foods can be seen for example in soy sauce (Stevens, 2021).

Another interesting finding was the divergent discourse of insect consumption, revealing a class divide in Singapore. While traditional media coverage of insects was relatively light and focused on it as a food source, social media conversations were rather lively and heated. Traditional media primarily framed their reporting around the sustainability and food security implications of consuming insects in Singapore. However, comments were more preoccupied with the look, taste, health, and safety aspects of insects for consumption as well as relished in sharing their own experiences in eating them as a sign of bravado. While insects are part of street food culture in Singapore's neighbouring countries and have been a common practice throughout history (Hunter, 2021), the comments predominantly were reactions of 'yuck', disgust, and rejection. Insects were aligned with 'peasants' while 'elites eat real food', who could instead presumably eat cultivated meat and plant-based meat. Although cultivated meat has been targeted to the high-end market, Singapore's traditional media features images of familiar and traditional Singaporean foods (i.e. hawker food chicken rice and satay) as an attempt to make the novel food relatable and accessible to all classes of Singapore. Nonetheless, the reality is that novel foods still remain largely inaccessible to the majority. This discourse of class divide resonates in Singapore more broadly with discussions of elitism, class, and taste, with high-end consumers being the preferred market and potentially having a wider range of food choices in comparison to the ordinary Singaporean.

Conclusion

Findings illustrate disagreement and misunderstanding between the state's high modernist aims and what people seem to actually want. By examining both traditional and social media, this study provides a comprehensive view of the perceptions and attitudes of the Singapore state and its people towards novel foods. No matter the evidence provided of the technological, environmental, and financial advantages of novel foods, we cannot forget that food is directly ingested and has an impact on the individual, physiologically, socially, and emotionally. While

traditional media referred to institutional regulations to address health and safety, addressing science may not be enough to change eating practices. Rather, emotions and values shape risk perception, so traditional media could embrace some of the concerns of people if the intent is to offer motivation for personal adoption or avoidance of certain foods.

Listening to voices from both traditional and social media, I hear a shared recognition that food matters to Singaporeans and that its production and consumption have an impact on society. Distinctly though, traditional media assumes the voice of the nation and frames the positive aspects of alternative proteins as benefiting the great good, not unlike Eastern collectivism. On the other hand, social media provides a platform for individuals to voice their concerns, not unlike Western individualism. Dubbed a country where "East meets West," Singapore's media also reflects this range of orientation.

The open platforms provided on social media allow people to share their individualism and their opinions beyond the limitations of regulated and controlled information of traditional media; it also provides a way to respond as well, as seen with comments on fermented protein. We must remember that people are not passive in their food choices, neither blindly accepting nor denying novel foods, but are part of the negotiation regarding what is determined acceptable and appropriate to eat.

Limitations to this study must be acknowledged. This study focused on five categories of novel foods (cultivated meats, plant-based food, insect protein, fermentation, and microalgae); as technology continues to evolve, the types of food (and categories) will continue to evolve and change as well. Further, this study draws specifically on data from Singapore, which is a small, young, modern nation. However, Singapore is known for its unique combination of Western and Eastern ideologies and practices, making it an interesting point of study and comparison. As food continues to be an important ideological and institutional tool, the field is ripe for more studies on the discourses of novel foods, especially in how new foods are being communicated and negotiated across media platforms.

Note

1. https://gfi-apac.org/industry/alternative-protein-company-database/

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ORCID

Keri Matwick http://orcid.org/0000-0002-4022-4303

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