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RESEARCH ARTICLE

Gross to gourmet: A social media analysis of Naked Clams as a sustainable delicacy

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Abstract

Amidst a global food crisis, securing sustainable food sources is vital. Bivalves such as Naked Clams, historically known as shipworms, offer a promising solution due to their low environmental impact, high nutritional value, and rapid growth rates. Contrary to their image as pests, Naked Clams are the fastest growing bivalves and have various health benefits. Believed to be the world's first aquaculture species, cultivated by Aboriginal Australians 8000 years ago, they are a delicacy in Southeast Asia. Public perception of Naked Clams remains largely unexplored, hindered by their association as pests and worm-like appearance. This study assesses the perception of Naked Clams through social media, analyzing 40 posts across Facebook, Instagram, TikTok, and YouTube, with millions of views and likes. Analysis of nearly 8000 comments revealed that public perception was split, though generally more positive than negative. Concerns included appearance, potential religious dietary conflicts, and the risk of parasites, which can be addressed with educational campaigns. Importantly, 84% of commenters who tried Naked Clams reported liking them. Naked Clams are noted for their high protein content, nutrient density, and health benefits, and are enjoyed in diverse culinary forms, from traditional raw dishes, to battered calamari-style street foods, to innovative recipes like Naked Clam ice cream. This study highlights the untapped potential of Naked Clams in global diets and calls for further exploration into moving Naked Clams from "gross to gourmet."

KEYWORDS
AI, culinary innovation, food security, novel foods, nutrient-dense foods, shipworms

1 | INTRODUCTION

1.1 | The global need for diverse, sustainable, nutrient-rich food sources

The global population is in urgent need of sustainable food sources that are not simply energy rich but critically nutrient dense. Today, just three plant crops—rice, wheat, and maize—comprise over 50% of all calories consumed, with a further five crops providing the next 25% (FAO). The monoculture farming systems and ultraprocessed, micronutrient-poor foods that this limited range of crops provide do little to secure environmental or human health (Farmery et al., 2022). Increasing dietary diversity and the nutritional density of our food can play a crucial role in making our food supply chains more sustainable and healthier (Willer et al., 2024; Xia et al., 2024). Diversity matters for food security, our health, the planet's health, economic health, and

social progress, and creates a more resilient food system, which also ensures the survival of cultural traditions and flavors (Farmery et al., 2022; Willer et al., 2024).

1.2 | The need to revive neglected and underutilized species

In aiming to provide more diverse, nutrient-rich diets, there is a critical need to ensure we explore opportunities to make use of neglected and underutilized species. These species can offer some of the lowest-hanging fruit regarding research and financial investment to bring a "new" food item to market, and they also have a biosecurity benefit in that we know they already persist in the natural environment and have been consumed in the past. "Forgotten" crop plants like quinoa, chia, and teff are key examples here. Quinoa was widely grown and consumed in the Andes for 7000 years, before production became near-zero for 400 years following the Spanish conquest and the replacement with maize (Bazile, 2023). Yet, with recognition of quinoa's key nutritional benefits and agricultural opportunities from the 1950s, production rapidly expanded, such that it is now farmed in over 123 countries worldwide and is renowned as a superfood rich in zinc, fiber, folate, and antioxidants and linked to improved cardiovascular health (Andreotti et al., 2022). Foods from the past can be a goldmine of opportunities for today.

1.3 | The value in breaking down social barriers for unappealing food sources

Alongside reutilization of traditional food species, there is also significant value to be gained from enabling consumption of food sources that some human societies may previously have viewed with disgust. *Fusarium venenatum* presents itself as a visually very unappealing pink yellow fungus, yet now brings in a revenue of over £230 million for the United Kingdom's Marlow Foods in the form of Quorn meat replacement products (Finnigan et al., 2024). Rebranding the fungus to become a product with a positive public image as a tasty nutritious meat-free protein was highly successful, to the point that many consumers do not know what Quorn comprises (Finnigan et al., 2024). Similar success stories are now emerging with the growing insect and cultured meat sectors (Dupont & Fiebelkorn, 2020).

1.4 | Naked Clams are the next opportunity as a previously neglected, underutilized, unappealing food source

Bivalves, and specifically Naked Clams, represent a neglected, underutilized, and often misunderstood food source—but one with groundbreaking global potential (Willer & Aldridge, 2020; Willer et al., 2023). Bivalves have already been widely reported as the most sustainable meat or fish food source on the planet, and are a rich source of key micronutrients including omega-3, zinc, iron, and selenium (Willer & Aldridge, 2020; Willer et al., 2021). Naked Clams are a group of bivalves that offer the potential to improve these environmental and nutritional benefits by an order of magnitude. Previously known as shipworms, these bivalves were rebranded as "Naked Clams" (Willer et al., 2023) to improve their appeal and marketability by shucking the notorious name linked to damaging wooden ships for a term that is more palatable, consumer-friendly and accurate (after all, they are bivalves—not worms). They possess highly specialized shells designed for drilling rather than protection, and their long, soft bodies extend well beyond these shells—hence the term "naked." As they do not expend energy on building thick shells, more energy is directed toward soft tissue growth, contributing to their status as the world's fastest growing bivalves. For instance, the species *Teredo navalis* can grow up to 2 mm per day (Needler & Needler, 1940; Paalvast & Van Der Velde, 2011), significantly surpassing the growth rates of conventional "large-shelled" bivalves like mussels, which typically grow at only 0.1–0.2 mm per day (Guillou et al., 2023; Lander et al., 2012). Naked Clams burrow into and feed on wood, turning it into protein (Li et al., 2022; Stravoravdis et al., 2021; Willer & Aldridge, 2020), and their unique symbiotic microbiome allows them to synthesize a range of micronutrients valuable to human nutrition, including vitamin B12 (Altamia et al., 2018; Altamia et al., 2021; Goodell et al., 2024; Pesante et al., 2021; Willer et al., 2023). The world's first aquaculture system for farming Naked Clams for food was developed in 2023, opening up a new wave of opportunities for sustainable, low environmental impact and nutrient-rich food (Willer et al., 2023).

There are, however, major challenges to be overcome regarding public perception of Naked Clams, particularly in Western culture. Naked Clams achieved notoriety during the age of sail by causing significant damage to wooden vessels, with one of the most famous examples being the stranding of Columbus in Jamaica during his 4th Voyage to the New World after scuttling his fleet (Nelson & Sundberg, 2023; Rayes et al., 2015; Willer & Aldridge, 2020). Today, they are still considered a pest, estimated to cause billions of dollars of damage to wood coastal structures per year (Li et al., 2022). Yet, this often overlooks the fundamental role they play as ecosystem engineers and keystone species, helping to transfer vast amounts of carbon (wood) from land to sea (Hendy et al., 2022; Shipway et al., 2016; Shipway et al., 2019). Naked Clams may also represent one of the earliest known forms of aquaculture, and could potentially have been cultured as early as 8000 years ago (Mcniven et al., 2021). Aboriginal groups in Australia historically utilized Naked Clams as a food source, harvesting them from naturally decaying wood in intertidal zones, or by creating additional habitats by strategically placing piles of swamp oak wood along riverbanks to encourage Naked Clam colonization for later harvesting (McNiven et al., 2021; Turner, 1971). Along the New South Wales coast, Naked Clams were known as "cah-bro" and one clan that lived along the estuarine areas of what is now Sydney were named the Cahbrogal or "shipworm clan" (Gardner, 2016). As of the year 2024, Naked Clams are only eaten domestically in a few select regions of Southeast Asia (particularly in the Philippines, where they are known as "tamilok") (Shipway et al., 2019), Australia and South America, where

they are wild harvested from the mangroves, and served battered or in raw marinade dishes (Willer et al., 2023). Elsewhere, Naked Clams are seemingly viewed with apprehension, with negative perceptions likely stemming from their common name of "shipworms," the appearance of some species, their association as marine pests, fear of parasites, and cultural and dietary concerns. There is, however, no quantitative evidence for this, and in order to understand whether there is a wider market for Naked Clams as a food source, it is critical to build a better understanding of current public perceptions and barriers to adoption.

1.5 | Contextualizing Naked Clams within broader seafood consumption perceptions

Existing scientific knowledge on public perceptions and barriers to seafood consumption can provide a valuable backdrop for new insights on Naked Clams. Today's perceptions are shaped by a complex interplay of factors, such as health concerns, environmental awareness, and cultural influences. On one hand, fish and seafood are widely recognized for their nutritional benefits, as the richest whole-food way to obtain omega-3 fatty acids, a major protein source, and one of the richest sources of key micronutrients including iodine, iron, and vitamins A, D, and B12 (Hicks et al., 2019; Magee & McCann, 2019; Willer & Aldridge, 2020; Willer et al., 2023). Health-conscious consumers demand fish and seafood due to their benefits for neurological and cardiovascular health, as well as for child development (Crona et al., 2023). However, growing concerns about overfishing, sustainability, and the environmental impact of aquaculture have led to a more cautious and critical view among certain segments of the population (Gephart et al., 2021; Willer et al., 2022). Additionally, issues related to food safety and farming practices, such as the presence of mercury and microplastics in fish, or the welfare of farmed fish, further complicate the public's attitude toward seafood (Godwin et al., 2021; Lozano-Muñoz et al., 2021; Quiñones et al., 2019). Cultural factors also play a role, particularly in many Western cultures where fish and seafood consumption is well below recommended guidelines—in the United Kingdom, for instance, average fish consumption is just 58% of the recommended 280 g per week (Watson, 2022). More specifically to bivalves, in-depth reports have been published on the current barriers and opportunities to increasing consumption of relatively under-loved foods such as mussels, with the report co-published by Europe's largest frozen food manufacturer, Nomad Foods, a case in point (Avdelas et al., 2021; Gawel et al., 2023; Willer et al., 2021). The public's attitude toward Naked Clams will likely develop around these themes of nutrition, sustainability, welfare, and culture, making it crucial that we begin to understand these perceptions.

This study therefore aimed to build an understanding of public perception and acceptance of Naked Clams, a task now made possible through the leverage of new artificial intelligence (AI) tools and social media. We analyzed almost 8000 comments across 40 social media posts on 4 different platforms posted over a decade (2014–2024), which accumulated over 44 million views and 1.4 million likes, in order to provide the most comprehensive understanding to date of consumer views on Naked Clams, and a basis to inform research and development attempts to bring this healthy and sustainable food source to the mass market.

2 | METHODS

To evaluate the public perception of Naked Clams as a food source, we analyzed the key search terms for Naked Clams ("kejuma," "priyang," "tamilok," "tatud," "tembiluk," and "turu") across four social media platforms (Facebook, Instagram, TikTok, and YouTube). This approach was broadly similar to that used by Nekaris et al. (2013) and Tsao et al. (2021) for work on threatened species and COVID-19. The term "shipworms" was not used as a search term as it is not associated with food and most videos related to the term focus on the biology, ecology, economics, or history of these animals. Resulting social media posts were selected based on a combination of views, likes, number of comments, and spread across the key terms, with 10 posts selected per social media platform. Post metadata, specifically the number of views, number of likes, number of comments, video duration, date, and title, were then compiled. A summary of the compiled metadata is shown in Table 1 below, and a full version shown in Table S1.

As well as metadata, individual comments were also analyzed manually in detail. Post comments, including nested comments, were downloaded into Microsoft Excel as a csv file using https://exportcomments.com. As it was not possible to download comments from private accounts, only comments from free accounts were downloaded. Comments were bulk screened through Google Translate to convert all text into English. Individual comments that were not fully translated were then processed through ChatGPT 4.0 for further translation into English. A list of prompts used are outlined in Table S2. Any remaining comments that could not be translated online were sent to native speakers for translation. Comments were then bulk copied into Microsoft Word and manually analyzed. To ensure the focus of our analysis remained on consumer perceptions of Naked Clams, we specifically analyzed comments that directly addressed Naked Clam consumption, taste, appearance, and other related factors. Comments that did not pertain to Naked Clams were considered irrelevant and thus discounted. Examples of such irrelevant comments included: comments complimenting the video quality or production style; general comments about the content creator's personality or appearance; off-topic discussions initiated in the comments; comments related to the video location; expressions of general enthusiasm or support that do not specifically address Naked Clams (e.g., "Love this video!," "Great job!," or "Subscribed," etc.); and ambiguous or indecipherable comments. This approach ensured that our findings accurately reflected genuine consumer attitudes toward Naked Clams as a food source. Examples of irrelevant comments are provided in Table S3.

Specific comments on Naked Clams were then analyzed based on negative and positive perceptions, the nomenclature used for Naked Clams in different regions, whether commenters were receptive to try Naked Clams as a food source, whether they recognized them as bivalves, whether they had been previous consumed and enjoyed, if

TABLE 1 Social media analysis metadata.

Platform	Video #	Video age	# Views	# Comments analyzed
Instagram	1	27/09/2017	120,127	52
	2	16/10/2020	581,176	97
	3	6/5/2019	–	162
	4	23/01/2024	1,100,000	86
	5	13/10/2018	–	95
	6	6/10/2021	–	1027
	7	27/03/2024	1,300,000	63
	8	28/02/2024	8,900,000	184
	9	27/03/2024	61,351	66
	10	25/08/2023	11,800,000	201
TikTok	11	4/4/2022	1,700,000	378
	12	7/2/2023	398,000	56
	13	22/10/2023	2,500,000	63
	14	27/08/2022	320,000	79
	15	27/03/2024	2,100,000	872
	16	22/10/2023	16,700	16
	17	13/03/2023	15,000	99
	18	18/01/2024	1,700,000	231
	19	7/10/2022	1,100,000	176
	20	16/07/2022	375,900	52
YouTube	21	23/07/2018	2396	145
	22	4/7/2018	245,590	626
	23	19/3/2022	38922	598
	24	28/07/2015	449,753	307
	25	11/1/2021	22,132	18
	26	24/01/2022	14,406	9
	27	29/05/2019	263,673	10
	28	6/6/2023	205,498	220
	29	24/6/2019	12,482	14
	30	7/12/2014	40,768	15
Facebook	31	25/03/2024	6,200,000	500
	32	unknown	587,000	500
	33	9/8/2023	2,000,000	161
	34	4/27/2018	33,000	94
	35	7/29/2015	215,000	494
	36	2/21/2024	561	30
	37	3/13/2020	74,000	42
	38	1/25/2024	11,000	23
	39	3/14/2020	3800	7
	40	6/22/2023	606	33
		Total	**44,508,841**	**7901**

they had never heard of Naked Clams, in addition to information on where they are typically eaten, how they are prepared and the most common apprehensions to their consumption. We then analyzed specific comments on Naked Clams, focusing on several key aspects: the positive and negative perceptions of Naked Clams; the diversity of nomenclature used for Naked Clams across different regions; the geographic locations where Naked Clams were consumed; commenters' willingness to try Naked Clams; recognition of Naked Clams as a bivalve or mollusk; the experiences of those who had previously consumed Naked Clams and whether these were positive or negative; instances where commenters had never heard of Naked Clams; information about the typical culinary preparations of Naked Clams; and the most common apprehensions related to eating Naked Clams. Examples of specific comments for all of these key aspects have been compiled in Table S4.

To understand the overall perception of Naked Clams across social media, we aggregated and analyzed comments from all four platforms. This approach ensured a comprehensive view of public sentiment by focusing on broader trends and themes rather than fragmented insights from individual platforms or posts, making the findings more robust and representative of public opinion.

Based on data derived from social media comments, locations of Naked Clam consumption were mapped in QGIS version 3.36.2, using 1:10,000,000 scale country and state/province boundary data downloaded from Natural Earth map database: https://www.naturalearthdata.com/.

3 | RESULTS

3.1 | Overview of social media interactions

We analyzed 40 videos across four social media platforms (Facebook, Instagram, TikTok, and YouTube), posted over a 10-year period (first and last videos posted on 7/12/2014 and 27/03/2024, respectively) with a combined total of 44.5 million views and 1.43 million likes. To gauge public sentiment toward Naked Clams, we then individually analyzed a total of 7901 comments (see Table 1).

3.2 | Social media perception of Naked Clams

From these comments, we found that the sentiment toward eating Naked Clams was fairly evenly split, with 931 negative and 1136 positive comments respectively (Figure 1A). The Shapiro–Wilk test indicated that the data were not normally distributed, and monotonic transformations failed to rectify this. Nonparametric analyses were therefore used to analyze response data. No significant difference was found between the mean number of negative versus positive comments (Wilcoxon signed-rank test, $W = 763$, $p = .73$). However, significantly more (84%) posters that had tried Naked Clams enjoyed eating them than those that did not (16%) (one-sample Z test for proportions, $Z = 30.92$, $p < .0001$, Figure 2B). A total of 230 individual commenters were receptive to trying Naked Clams, 316 recognized them as bivalves, and 191 posters admitted to having no previous knowledge of these animals.

3.3 | Common aversions and marketing insights

From the almost 8000 comments analyzed, we were able to quantify the major aversions toward eating Naked Clams. The largest aversions were feelings of apprehension, nausea or sickness (697 comments), followed by appearance (194 comments), religious concerns (66 comments), and worries over disease or parasites (52). More minor concerns include tryphophobia (discomfort or disgust at seeing patterns with many small holes), the association with the name worm/shipworm, fear of poisoning, and texture (31, 25, 21, and 20 comments, respectively). Trivial concerns were expressed (e.g., aroma, flavor, status, etc.), but these totaled only 31 comments. These aversions are displayed in Figure 2.

3.4 | Geographic distribution and cultural significance

Our findings reveal that Naked Clams were eaten across three continents, encompassing Asia, Australia, and South America (Figure 3). In Asia, they were commonly eaten in the Philippines (including Mindanao, Mindoro, Palawan, and Panay), where they are known locally as "tamilok," "tambilok," and "tatod," and Indonesia (including Borneo, Java, Papua, and Sulawesi), where they are called "kejuma," "tambelo," "tambiluk," and "tempiluk." In Thailand, Naked Clams are known as "priyang" and are eaten on both the Andaman Sea and Gulf of Thailand coasts, but are best known from Chanthaburi and Trat provinces in eastern Thailand. Our analysis of comments also revealed that Naked Clams were eaten in Malaysia and Papua New Guinea, but no specific locations were given. In Australia, Naked Clams are eaten by the Yolngu or Yolŋu, an Aboriginal Australian people inhabiting north-eastern Arnhem Land in the Northern Territory. Here, Naked Clams are known as the "yuwurli" or "wakatapa" mangrove worm depending on the species (*Bactronophorus* sp. and *Bankia australis*, respectively). In South America, Naked Clams are eaten in the State of Maranhão, north-eastern Brazil. Interestingly, our analysis of comments revealed a town in Maranhão called "Turu" (São José), which is the local name for Naked Clams in Brazil.

3.5 | Anecdotal health benefits and culinary practices

Social media comments revealed a diversity of anecdotal health benefits linked to consuming Naked Clams. This most commonly included their use as a male aphrodisiac, a supplement for lactating mothers, and as a healthy, high protein food source rich in vitamins and minerals. Other posters mentioned their use as a sickness tonic or medicine and their use as a cure for hangover.

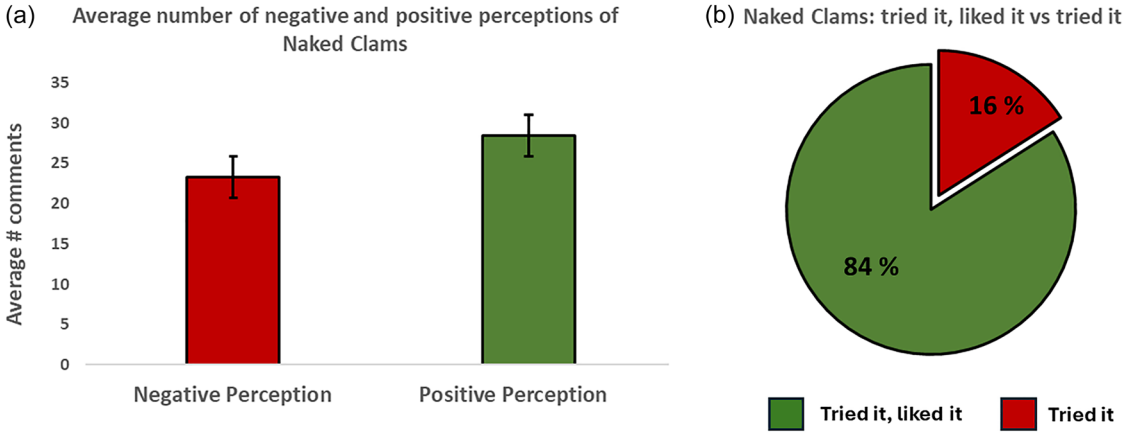

FIGURE 1 The social media perception of Naked Clams. (a) Average number of negative and positive comments on Naked Clams per video across four social media platforms (Facebook, Instagram, TikTok, and YouTube). (b) Of the commenters that tried Naked Clams, 84% enjoyed them. Data analyzed were a total of 7901 comments.

Aversion	#Comments
Disgust, nausea, sickness	697
Appearance	194
Halal/haram	66
Disease or parasites	52
Trypophobia	31
Poisoning	26
Worm name	21
Texture	20
Environmental concerns	9
Flavour	8
Cultural	5
Status	4
Vegetarian	2
Aroma	3

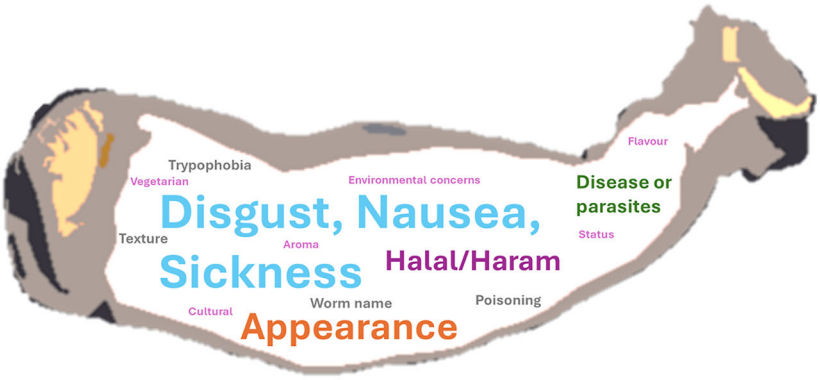

FIGURE 2 Major aversions toward the consumption of Naked Clams based on the analysis of social media comments. Specific aversions are quantified in the table on the left, and depicted in a word cloud within a graphic of a Naked Clam on the right.

We found that Naked Clams were prepared and enjoyed in a variety of different dishes (Figure 4). They were commonly eaten raw and straight from the wood, or straight from wood with a combination of chili, lemon, and vinegar as condiments. Other preparations included Naked Clams as a main ingredient in broths, soups and stews, ceviche, battered and deep-fried, in smoothies, and even added as an ingredient to halo-halo ("Tamihalo"), a common ice cream dish in the Philippines.

4 | DISCUSSION

4.1 | Positive image is king

The global need to provide nutritionally diverse, appealing, sustainable foods is urgent—and critically this requires us to understand candidate food items with potential to cause a landslide shift in food consumption patterns. Our study investigated the social media perception of Naked Clams (shipworms)—an under-exploited, nutrient-dense, low environmental impact food source. By leveraging social media analytics and AI tools, we identified clear signposts on how to shift public perception toward embracing Naked Clams, thereby allowing integration of these bivalves into global diets, which will enhance food diversity, security, and sustainability.

This analysis has revealed several fundamental points regarding public perception of Naked Clams, which underpin the notion of taking Naked Clams from "gross" to "gourmet." Most critically, we now understand that whilst before tasting Naked Clams negative and positive perceptions are matched, after tasting Naked Clams the vast majority—84%—of people liked them. We also now have quantitative data that "disgust, nausea, sickness" and "appearance" represent the biggest aversions to trying Naked Clams. This indicates that changing the image of Naked Clams into something more visually appealing could be an effective mechanism to support increased human consumption, by overcoming the first hurdle of "trying" the product. Studies on other "unappealing" foods like insects, demonstrate that improving food image plays a significant role in reducing negative perceptions in a consumer retail context, and also that changing the menu description in restaurants significantly reduces negative perceptions (Baker et al.,

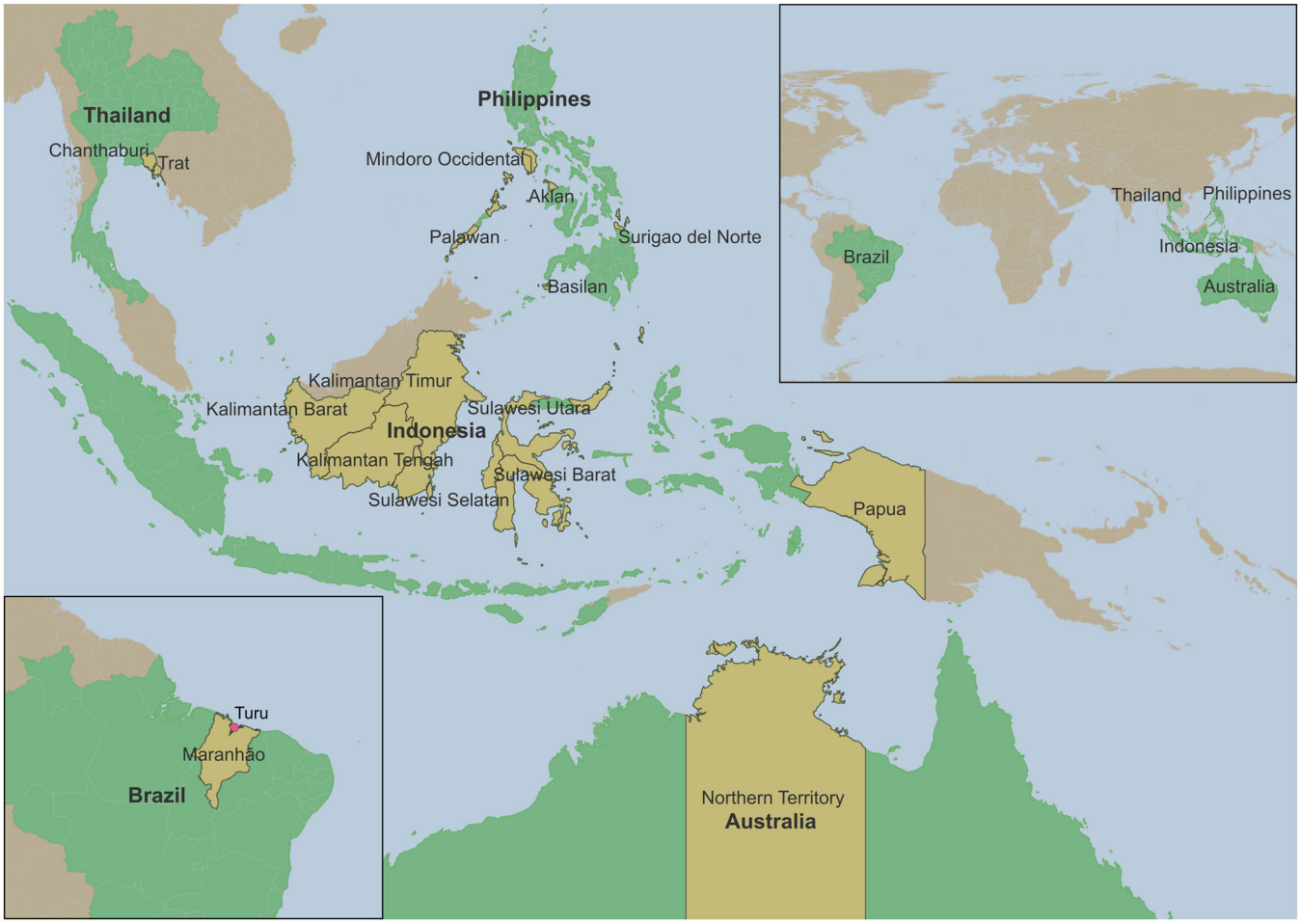

FIGURE 3 Geographic distribution of Naked Clam consumption based on analysis of social media comments. Locations of Naked Clam consumption, based on 1:10,000,000 scale country and state/province boundary data, downloaded from the Natural Earth Map database (https://www.naturalearthdata.com/).

2016; Florença et al., 2022). We also know from studies on bivalves specifically that repackaging them into processed foods that resemble other familiar food products can offer the most effective means by which to increase consumption (Crona et al., 2023; Willer et al., 2021), and that from studies on fish products in general a high level of familiarity and convenience helps increase appeal to consumers (Willer et al., 2024). This provides further confirmation on the merits of rebranding shipworms as Naked Clams (see Willer et al., 2023), and also on the value of "disguising" Naked clams in familiar processed foods like battered or fried products, burgers, fish fingers, or cakes (Gawel et al., 2023; Willer & Aldridge, 2020; Willer et al., 2023; Willer et al., 2021).

Despite analyzing only English characters in social media posts, our study reveals that Naked Clams are consumed in several countries across three continents—home to hundreds of millions of people. The inclusion of search terms in additional language scripts is likely to uncover unknown hotspots of Naked Clam consumption, but was beyond the scope of the present study. Notably, in places like Palawan, Philippines, and among Yolngu Aboriginal Australians, Naked Clams are celebrated as a prized delicacy. Indeed, we highlight the striking parallels between the Aboriginal Cahbrogal or "shipworm clan" from New South Wales, Australia, and the town named "Turu" (the common name for Naked Clams in Brazil), in the State of Maranhão, Brazil, where Naked Clams were reported to be commonly eaten. It is remarkable that these animals are of such significant cultural importance as to inspire the naming of both a people and place in their honor. Our findings further indicate that Naked Clams are enjoyed in a variety of culinary forms, including harvesting directly from mangrove trees for raw consumption, preparation in elaborate gourmet dishes, and even incorporated into a popular ice cream dish halo-halo ("Tamihalo"). Naked Clams, already considered a delicacy, are enjoyed worldwide and can be considered a versatile dish with significant mass market appeal.

4.2 | Parallel sectors for exploitation of Naked Clams

The research has also uncovered several unique attributes regarding traditional Naked Clam consumption that could be exploited to increase the consumer and food industry interest in Naked Clams on

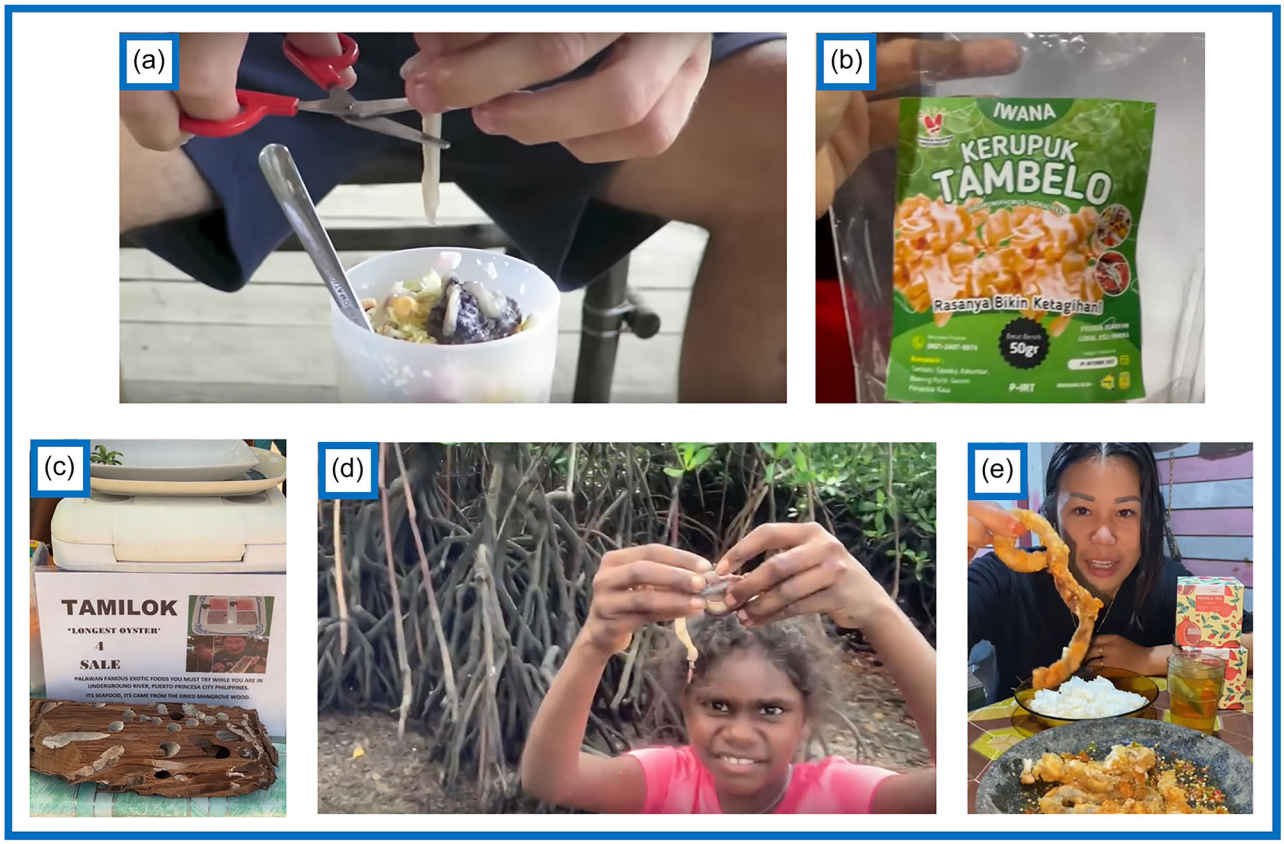

FIGURE 4 Culinary diversity of Naked Clams. (a) "Tami-halo"—a hodgepodge of "tamilok," the common name for Naked Clams in the Philippines, and halo-halo, a popular ice cream desert in the Philippines. (b) "Tambelo" flavored crackers in Indonesia. (c) A roadside stall selling raw "Tamilok" dipped in vinegar and calamansi, Philippines. (d) Raw Naked Clams eaten direct from the mangroves in the Northern Territory, Australia. Deep-fried "tambelo," Indonesia. Images A–E taken from video #24, 12, 7, 29, and 15, respectively (video numbers shown in Table 1).

a global level. The Naked Clam food types analyzed can be divided into two forms: those with longer preparation times, a "higher end" feel, that might be served in a restaurant, and where the Naked Clam is often more visible, such as in raw marinades or soups; and those where the Naked Clam is a convenience food, such as in battered strips, crackers, or ice cream. This highlights an opportunity to break into two major markets and revenue streams—the food service sector and the mass-market retail sector (Willer et al., 2021). It is already established that high-profile chefs can be powerful change makers in bringing traditional indigenous and sustainable foods to the food service sector (Pereira et al., 2019), and also that mass-market processing can lead to rapid expansion of novel foods (Campanati et al., 2021; Gawel et al., 2023; Willer et al., 2021), with the growth of the Packaged Processed Insect (PPI) industry in just 10 years to over 300 major companies a case in point (Reverberi, 2020).

We also emphasize that our study suggests there may be benefit in exploring the pharmaceutical potential of Naked Clams or their application in wellness products, given the anecdotal use as a reported male aphrodisiac and a supplement for lactating mothers. Tongkat ali (*Eurycoma longifolia* Jack) is another traditional food item from Southeast Asia with properties benefiting reproductive function, and these properties are now scientifically proven, with Tongkat ali extract reaching a market value of USD $76 billion in 2023 (Bhat & Karim, 2010). A Naked Clam pharmaceutical sector at even a fraction of this size could be a powerful means to also encourage consumption of Naked Clams as food. Finally, we highlight the common anecdotal reports of Naked Clams as a general tonic for health and sickness. Recent research has revealed that Naked Clam symbionts are a veritable treasure trove for natural products and drug discovery (Altamia et al., 2020; Han et al., 2013; Lacerna et al., 2020; Miller et al., 2021; O'connor et al., 2020). Future research should endeavor to verify the pharmacological benefits of eating Naked Clams and explore their commercial potential in the health and wellness sectors—potentially further boosting their acceptance and use as a nutritious health food.

4.3 | Social media and AI provide a powerful window into consumer attitudes

Our methodical examination of social media activity across four key platforms revealed a multifaceted understanding of global consumer perceptions toward Naked Clams. The extensive data harvested—including millions of views, likes, and thousands of comments—highlights the volume of interactions and nature of consumer engage-

ment with this novel food product. AI tools were effectively employed to efficiently gather and manage this large dataset, and to then understand, interpret, and process comments by translating posts from various languages into English, ensuring that the analysis was not limited by language barriers, or sentiment misinterpretation. ChatGPT 4.0 has demonstrated a variety of capabilities, including completing complex tasks, natural language translation and analysis of social media comments (Jiao et al., 2023; Taecharungroj, 2023; Tupper et al., 2024; Willer et al., 2024). Our use of ChatGPT 4.0 was particularly helpful in this regard, as its understanding of natural language and user-friendly interface allowed us to quickly decipher the meaning and sentiment of more vernacular posts that Google Translate could not. This rich data set allows us to understand and harness the power of public opinion to inform critical decisions on the preparation, marketing, and positioning of Naked Clams in various culinary markets. Insights drawn from these interactions suggest that while Naked Clams are recognized as a delicacy in certain cultures, widespread acceptance varies significantly.

Key influencers across the culinary world, alongside educators and policymakers, play a pivotal role in shaping the narrative surrounding such novel food items. By employing strategies that enhance the public image of Naked Clams—such as educational campaigns, culinary demonstrations, and targeted social media content—there is a substantial opportunity to modify consumer perceptions positively. These efforts can demystify Naked Clams, address common apprehensions, and highlight their culinary versatility, health benefits and environmental and sustainability credentials. Furthermore, the active involvement of policymakers and culinary influencers could catalyze a shift in public opinion of Naked Clams from a regional specialty into a globally embraced delicacy. The authors note that to this end, upon completion of the study, the Financial Times invited a group of celebrity chefs to devise high profile and appealing recipes for Naked Clams that they could envisage serving as flagship menu items in restaurants (Drake, 2024), effectively transforming them from "gross to gourmet."

5 | CONCLUSION

Our study revealed that Naked Clams are consumed across a diverse geographic range, including regions in Asia, Australia, and South America, with the vast majority (84%) of those who have tried them reporting positive experiences. These clams are enjoyed in a variety of culinary forms, from being eaten raw straight from the wood, to traditional marinade dishes, to battered street foods and complex preparations. Additionally, we identified numerous anecdotal references to their use as a health food, sickness tonic, aphrodisiac, and supplement to fortify breast milk, suggesting promising avenues for future research to quantitatively validate their potential as a health-promoting food.

Our analysis also highlighted the varying degrees of acceptance toward this novel food, revealing both challenges and opportunities for its wider adoption. These findings emphasize the importance of developing targeted strategies—including educational programs, culinary innovations, and marketing campaigns—to address the identified negative perceptions and promote the significant environmental and health benefits of Naked Clams. By doing so, Naked Clams could play a significant role in addressing global food security challenges and reducing the negative environmental impacts of modern diets, while supporting a cultural shift toward more sustainable eating habits, ultimately benefiting both human health and the environment.

This investigation demonstrates that social media offers an unprecedented platform to gauge and influence consumer opinions, and its strategic utilization can be pivotal in overcoming biases associated with less conventional food sources. By leveraging the vast information available on digital platforms like social media and employing powerful emerging technologies like ChatGPT for accurate language translation and nuanced sentiment interpretation, our study provides a framework for future research on how novel foods can be accepted and integrated into mainstream diets.

Naked Clams represent the potential of alternative novel proteins to advance global food sustainability and resilience, demonstrating how strategic efforts can elevate such foods from "gross to gourmet."

AUTHOR CONTRIBUTIONS

JRS: Conceptualization, data curation, methodology, analysis, writing, resources, funding acquisition. MT: Data curation, methodology, analysis, writing, resources. DFW: Conceptualization, writing, resources, funding acquisition.

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CONFLICT OF INTEREST STATEMENT

JRS and DFW are Directors of Naked Clam Limited. There are no further competing interests to declare.

ETHICS STATEMENT

No additional ethical considerations were applicable to this research.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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