



What's the big ick?

What's the big ick?

Examining how behavioural
change can shift perceptions
about eating insects

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Abstract

This study explores the current landscape of entomophagy in Canada from gauging Canadians' acceptance of insect consumption to investigating how behavioural change strategies can encourage regular insect consumption. The research comprises a comprehensive literature review to expand our knowledge of global entomophagy practices, consumption barriers, and behavioural change; expert interviews to gain insights into the present state of entomophagy in North America; and an on-line survey to examine Canadians' consumption patterns.

The outcome of this project is behavioural change strategies that encompass rebranding insects, fostering safe spaces, nurturing aspiration, leveraging media influence, and introducing targeted education. In essence, the study enhances our comprehension of the barriers to entomophagy adoption in Western countries and lays the groundwork for future research and initiatives aimed at promoting insects as a viable supplementary protein source. By promoting sustainable food practices, entomophagy can address global food system challenges such as hunger, food waste, and food insecurity, thereby contributing to a more sustainable future for all.

Acknowledgements

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As Treaty people, we acknowledge the continued impacts of colonialism and the need to work towards decolonizing our work and practices. We commit to listening and learning from Indigenous Peoples and working to incorporate their knowledge and outlooks into our work.

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Report structure

This report is divided into five parts.

What is entomophagy?

This section explores the history of the human consumption of insects, examines the multifaceted relationship that humans have with insects, explores the environmental and health benefits of incorporating insects into the human diet, and provides a view of the current state of entomophagy worldwide.

Entomophagy in Canada

This section encompasses an exploration of insect consumption in Canada including its history and present state. This examination encompasses the emergence of new businesses, government funding, research initiatives, and the emergence of conspiracy theories. In order to develop a common understanding of the system, an Iterative Inquiry and Stakeholder Map was created.

Canadians' insect consumption

This section explores Canadians' values, consumption patterns, and attitudes toward consumption, with a particular focus on insect consumption as ascertained from survey responses. Additionally, it delves into the difficulties confronted by stakeholders in the entomophagy industry and their strategies for overcoming them, through information gathered from interviews. Additionally, a brand analysis has been conducted to understand the various promotional techniques used by Canadian brands.

Behavioural change

This section begins with the identification of the key stakeholders who hold the power to make change, substantiated by the creation of an Influence Map. It also includes an application of the COM-B model to discern the present behaviours of the identified target group. Additionally, this section encompasses the utilization of the Behaviour Change Wheel to determine prospective intervention functions, policies, and behavioural change techniques. Finally, the evaluation of the behavioural change techniques is conducted using a modified APEASE criteria.

Building a strategy

This section encompasses an investigation of pull strategies and their potential role in facilitating behavioural change. Subsequently, we present high-level intervention strategies based on the behavioural change techniques identified in the preceding section.

Key terms

Entomophagy

Entomophagy is the human practice of eating insects (UC Riverside, 2022).

Traditional Proteins

Traditional proteins are animal-based sources of protein such as meat, poultry, fish, eggs, and dairy products. These have been the most common sources of protein in human diets for centuries.

Alternative Proteins

Alternative proteins are protein-rich ingredients sourced from plants, insects, fungi, or through tissue culture to replace conventional animal-based sources (Bashi et al., 2019).

Systems Thinking

An understanding of the flows, relationships, and behaviour of parts within a system to enable the potential for changes or improvements to produce intended behaviours and outcomes effectively (Jones & Van Ael, 2022).

Behavioural Change

A systematic approach to changing behaviour (American Psychological Association, n.d.).

Consumption Habits

The patterns of behaviours an individual exhibits when interacting with goods and services.

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Context

The global food system is facing multiple challenges. The number of individuals affected by hunger worldwide has risen to an estimated 828 million in 2021 — an increase of approximately 46 million since 2020 and 150 million since the onset of the COVID-19 pandemic in 2019 (Food and Agricultural Organization, 2022). Current projections indicate that the world is unlikely to achieve Sustainable Development Goal 2, Zero Hunger, by 2030, and despite some advancements, most indicators remain off track for meeting global nutrition targets (United Nations, n.d.). In 2020, nearly 3.1 billion people were unable to afford a healthy diet, an increase of 112 million from 2019, reflecting the consequences of inflation in consumer food prices due to the economic ramifications of the COVID-19 pandemic and the containment measures implemented in response (Food and Agricultural Organization, 2022).

As of 2023, the ongoing conflict in Ukraine, involving two of the world's largest producers of staple cereals, oilseeds, and fertilizer, is disrupting international supply chains and driving up the prices of grain, fertilizer, energy, as well as ready-to-use therapeutic food for children suffering from severe malnutrition. This escalation occurs amidst supply chains already facing adverse effects from increasingly frequent extreme climate events, particularly in low-income countries, and carries potentially grave implications for global food security and nutrition (Food and Agricultural Organi-

zation, 2022). Food waste and food insecurity continue to be pressing issues worldwide, while population growth and a rising middle class contribute to an increase in environmentally challenging meat consumption (Food and Agricultural Organization, 2021). As such, a growing awareness of the unsustainable nature of traditional protein sources, has led to the exploration of alternative sources of protein.

Entomophagy, the consumption of insects by humans, presents a potential solution to these challenges. According to the United Nations Department of Economic and Social Affairs, insects are consumed by over two billion people worldwide (n.d.). While it is difficult to determine if this is an accurate figure, researchers conservatively estimate the number is still several hundred million (van Huis, 2021). There are also over two thousand species of edible insects including crickets, mealworms, grasshoppers, beetles, caterpillars, bees, wasps, and ants. Although entomophagy is commonly practiced in countries within Africa, Asia, Latin America, and Australia, it remains taboo in Western developed countries (Food and Agricultural Organization, 2021). Research has suggested food neophobia (the fear of novel foods), unfamiliarity with insects as food, viewing insects as a primitive food, and high levels of disgust, or the “ick” factor, as reasons why Westerners remain hesitant about entomophagy (Hamerman, 2016). However, incorporating insects in the



Figure 1: Gathering caterpillars in Africa

form of powders and functional foods has recently gained traction in the Western diet as a more sustainable avenue for protein sources (Global Market Insights Inc., 2016).

Studies have shown that insects are not only more environmentally friendly but also offer a nutrient-dense alternative to traditional livestock. Insects produce fewer greenhouse gas emissions and require less land and feed than traditional livestock (McKinsey & Company, 2021). Additionally, insects provide a complete amino acid profile and essential fatty acids, which are not typically found in traditional livestock. With the global population currently exceeding 8 billion people and expected to grow to 10 billion people by 2050, there is an expanding need for high-quality, nutritious, and sustainable protein sources (U.S. Census Bureau, 2017).

Insect protein may be a suitable alternative to traditional sources of protein as a sustainably produced, high-quality, and natural protein source for human consumption. Insect powders, such as cricket protein powder, may be more acceptable to non-traditional consumers of insects and can be used in various food products, including protein bars (Food and Agricultural Organization, 2021). This study aims to investigate the potential of promoting entomophagy within Canada and understanding human behaviours associated with influencing people to adopt insects as a viable protein source within their diets.

Problem statement

Over the past five years, there has been an exponential increase in publications on the practice of entomophagy (Kavle et al., 2022; van Huis, 2022), including research on rearing insects, food science, consumer behaviour, and policy. These publications tout the multitude of benefits of entomophagy and a growing acceptance of consumers to consume insects, but widespread adoption has yet to occur in Western countries.

A large part of the research in Canada to date has focused on understanding consumers' knowledge, acceptance, and willingness to consume insects (Barton et al., 2020; Dion-Poulin, 2021; Hénault-Ethier, 2020). Though the results of these studies show that Canadians are willing to consume insects, there is still a lack of widespread consumption. Through our research, we aim to bridge this gap by gaining a more comprehensive understanding of the deep-rooted cultural, societal, environmental, and ethical barriers that inhibit entomophagy and develop strategies that could drive the behavioural change needed for adoption.

Although our research focuses on developing strategies for changing the behaviours of Canadians toward the consumption of insects, the findings may be of use to others who are facing similar issues of behavioural change in other areas.

Research purpose

This research project has three main goals.

First, it seeks to understand the history and current practice of entomophagy in Canada. In doing so, we will explore who the key actors are in the system and what leverage they hold.

Second, the project explores Canadians' consumption behaviour and their current appetite for insects. We will also examine what current strategies exist for promoting insect consumption.

Third, it aims to develop intervention strategies for how the industry might be able to promote the regular consumption of insect proteins through behavioural change. To do so, we will identify target behaviours of consumers that need to be changed and explore possible behavioural change strategies.

Research question

Our project was guided by the following question:

How might we promote the acceptance of insects as a viable supplementary protein source to a wider audience in the Canadian market and encourage more sustainable food behaviours?

To further define the scope of our research project, we also asked the following questions:

What are the deep cultural, societal, environmental, and ethical reasons for the lack of insect consumption in Canada?

What are the existing difficulties encountered by entomophagy businesses?

What are feasible strategies to change the behaviour of Canadian consumers?

Methodology

Our research method began with the first three exploratory stages outlined in *Design Journeys through Complex Systems* (Jones & Van Ael, 2022). These stages of the toolkit focus on developing an understanding of the current system. After this, we shifted toward understanding the specific behaviours of a segment of consumers and developed implementation strategies for behavioural change. Throughout the course of our research, we utilized a variety of systems, strategy, and behavioural change tools to understand the context and conduct of entomophagy in Canada. Our process was sequential in that each stage informed the work in the following stage.

Framing the System

The first stage of the process served to define the scope and boundaries of the current system. The scope and boundaries established during this phase will help create a common understanding of the system and serve as a reference point for the next phases of the process. In this phase, we have completed the Iterative Inquiry to deconstruct the entomophagy system into its structures, processes, and functions. Based on this information, we created a Stakeholder Map to identify who exists in the system and how they relate to one another. These maps were informed by information gathered from an extensive literature review.

Literature review

We conducted a literature review to deepen and broaden our understanding of the global practice of entomophagy, barriers to consumption, and approaches to behavioural change. The literature reviewed included over 120 references from various sources including peer-reviewed journals, books, statistical data, and website material.

Iterative Inquiry

The Iterative Inquiry is a tool developed by Jamshid Gharajedagi (2012), used to define the boundaries and understand the elements of the system under investigation. The tool also defines the purpose, functions, structures, and processes in each subsystem. Completing the Iterative Inquiry allowed us to define the focus of our research and begin to identify key actors.

Stakeholder Map

The stakeholder map is a tool used to identify the key actors — organizations and individuals — within a system. Stakeholders were identified through our literature review as well as through our Iterative Inquiry. This research project used a knowledge and power matrix to identify who has the most influence on outcomes in the system. By creating an initial stakeholder map at the outset of the project, we identified who to prioritize through our interviews. As we gathered more information about the system throughout our project, we updated this map.

Listening to the System

The second phase of the process involved primary research geared toward understanding the perspectives, motivations, and barriers of consumers in Canada as well as the systemic forces that cause their behaviour. In this phase, we conducted expert interviews to better understand the challenges within the entomophagy industry, an online survey to understand consumer consumption habits and attitudes, and autoethnographies to capture our personal experiences and feelings related to the topic.

Expert Interviews

We conducted semi-structured interviews with individuals working in entomophagy in North America. These interviews helped us understand the challenges within the entomophagy industry and what strategies they are using to address them (see Appendix A for our interview guide). Of the 21 individuals we contacted, 9 agreed to participate in our research project.

The experts can be classified into three distinct groups:

- 22% academic researchers
- 67% business owners
- 11% chefs

These experts were based in:

44% Canada

56% United States

We began recruitment by approaching experts in Canada with varied experiences in the entomophagy industry. From there, we used a snowball technique asking experts for recommendations for who we should speak to next.

We analyzed and synthesized data using the qualitative analysis tool Dovetail, employing coding and thematic analysis (see Appendix B). We followed a structured data analysis method involving:

- i) coding interview transcriptions
- ii) segregating coded data into emerging themes
- iii) analyzing thematic groups, and recording insights

We further prioritized insights using the Radar plotting visualization tool. The insights identified were ultimately applied to the COM-B model to develop intervention strategies aimed at influencing Canadians' eating habits, which the insect protein industry could leverage at large.

Survey

To better understand the specific consumption habits and attitudes toward insect consumption of Canadians, we developed an online survey. The goal of the survey was to reveal how consumers feel about eating insects versus other protein alternatives; what personal, psychological, and social factors influence consumers to choose what protein they consume; and how the consumers' environment influences their consumption habits. We also gathered demographic information including ethnicity, income, age, and gender in an attempt to establish patterns (see Appendix C for our survey questions). We received 182 total responses and 168 were eligible to participate.

The participants were aged:

11.8% 18-24

47.5% 25-34

13.6% 35-44

7.9% 45-54

9.6% 55-64

9.6% 65+

And lived in:

52.9% Alberta

7.7% British Columbia

0.0% Manitoba

29.8% Ontario

2.4% Quebec

1.2% Saskatchewan

3.6% Maritimes (Newfoundland and Labrador, New Brunswick, Nova Scotia, Prince Edward Island)

0.0% Territories (Northwest Territories, Nunavut, Yukon)

2.4% Not disclosed

Of the participants:

58.8% have never consumed an insect

31.1% have tried an insect once

10.1% consume insects more regularly

We analyzed the survey data by:

i) cleaning the data by checking for missing data and errors

ii) using cross-tabulation to identify any differences in behaviours between groups based on demographics

Like the insights from the interviews, we applied them to the COM-B model to identify plausible intervention strategies.

Autoethnography

To supplement our interviews and survey, we conducted an autoethnographic study. Autoethnography is a research method that uses personal experience to describe and interpret experiences, beliefs, and practices (Adams et al., 2017). Throughout the course of our research project, we challenged ourselves to research and purchase insect products, prepare meals with them, and finally consume them. We recorded our feelings, experiences, and observations and connected them to our other research findings (see Appendix D).

Understanding the System

The third stage was the completion of the analysis of the current system by synthesizing key findings from the earlier phases, and integrating them into visual explanations. During this stage, we developed an influence map to make sense of influences that exist

between stakeholders and also identified a system archetype that helps explain the root of why consumers have yet to consume insects widely.

Influence Map

To make sense of the data collected, we developed an influence map. Influence mapping is a technique for locating the patterns of influence in a complex system (Jones & Van Ael, 2022). This tool allowed us to identify who holds influence and informed who we could build strategies for.

The mapping exercise revealed crucial insights. Firstly, the Government of Canada and consumers hold significant influence in driving the acceptance and commercialization of insects as an alternative protein source. Secondly, insect protein producers and processors serve as key stakeholders, spearheading commercialization and innovation within the industry. Lastly, food retailers (grocery stores and restaurants) and social influencers play a role in fostering behavioural change by showcasing the latest products, catering to market and consumer needs, and contributing to the popularity of insect protein.

System Archetypes

System archetypes are recurring patterns of behaviour that are found in complex systems (Senge, 2006). From the research gathered, we used system archetypes to hypothesize the central problems in the entomophagy system.

The insights gleaned from our survey indicated a “Shifting the Burden” archetype, where respondents acknowledge the benefits of insect consumption but hesitate to embrace it due to cultural norms, personal attitudes, and fear of judgment. Despite recognizing insects’ role in promoting environmental sustainability, and potential high-nutrition values, respondents’ hesitancy stems from unfamiliarity with insect-based foods and concerns about negative perceptions. This indicated a need to shift attitudes and facilitate the acceptance of insects as a food source across diverse demographics.

Exploring Behavioural Change

The fourth stage of our process explored the various avenues of creating behavioural change. In this stage, we considered different behavioural change models, and after deciding upon the

COM-B model, we applied it to identify the current target behaviours of our target group, establish their ideal behaviour, and develop possible behavioural change techniques.

COM-B Model

The COM-B model is a behavioural change framework that helps to understand the factors that influence behaviour and how to change it effectively. It was developed by Susan Michie, Maartje van Stralen, and Robert West in 2011. The model cites capability (C), opportunity (O), and motivation (M) as key factors to effect a change in behaviour (B). We have used the COM-B model alongside the Behaviour Change Wheel to identify the most effective behavioural change strategies based on the elements of the COM-B model. We used the APEASE criteria, as defined in the Behavioural Change Wheel process, to evaluate which behavioural change techniques could have the greatest potential for change.

Developing Intervention Strategies

The fifth and final stage built on the behavioural change techniques identified in the previous stage and proposes a set of pull strategies that aim to create the desired behavioural changes.

Pull Strategy

A pull strategy is a marketing approach that focuses on attracting consumers to a product or service through natural strategies, rather than imposing the product on the consumer. Pull strategies generally aim to create demand and desirability for a product through advertising, promotion, events, and other public relations efforts. By emphasizing positive experiences, sensory appeal, and unique selling points, pull strategies can create a sense of curiosity and interest in the product, leading consumers to seek it out and ultimately driving demand (European Commission, 2009). As such, the pull approach was used to develop intervention strategies to promote the acceptance and consumption of insect-based food products through environmental restructuring, positive modelling, and education.

Entomophagy: An overview

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History of humans eating insects

Historically, diets have included a variety of locally and regionally available plants and animals. Today, around 40 species of animals make up all of livestock production, with only a small subset producing most of the globally available meat, milk, and eggs (Food and Agricultural Organization, 2019). More than ever, there is an impending need to expand our palates and improve both human nutrition and the environment through the diversification of food choices.

The world population is projected to reach nearly 10 billion by 2050 and the increasing demand for food will put immense pressure on agricultural systems and natural resources. Traditional agricultural practices, particularly livestock production, contribute significantly to environmental degradation through deforestation, water pollution, greenhouse gas emissions, and biodiversity loss. Climate change exacerbates these challenges by affecting crop yields, water availability, and the increase of harmful fertilizers in the environment. Furthermore, traditional protein sources, such as meat and dairy, are resource-intensive, requiring vast amounts of water, land, and feed. Expanding our palates and embracing food alternatives can not only reduce the strain on finite resources but also lead to a richer culinary landscape, foster innovation in the food industry, and promote cultural exchanges (Food and Agricultural Organization, 2013).

Globally, more than 2000 species of insects are known to be eaten, constitut-

ing a major source of nutrition and part of regular diets for over 2 billion people in 130 countries (Food and Agricultural Organization, 2013). Most edible insects are gathered from the wild, but rearing or farming insects for animal feed and human consumption has become increasingly more common and is in the early stages of commercialization (Food and Agricultural Organization, 2013). Compared to traditional livestock production systems, insect rearing uses 50-90% less land per kg of protein produced and 40-80% less feed per kg of edible weight, produces 1.2-2.7 kg less greenhouse gas emissions per kilogram of live weight gain, and uses 1,000 L less water per kilogram of live weight gain (Espitia Buitrago et al., 2021).

Historically, human diets have been shaped by the availability of food resources in their local environments. Insects are abundant and easily accessible sources of nutrition, and have been a crucial part of ancestral diets across various regions (Food and Agricultural Organization, 2013). Archaeological evidence, such as insect remnants in prehistoric human settlements, confirms the presence of entomophagy in ancient civilizations (Jongema, 2017).

Over time, the consumption of insects declined in certain societies, particularly in Western cultures. The reasons for this shift can be attributed to a combination of factors. The agricultural revolution and the domestication of plants and animals altered human diets by providing



Figure 2: A central Pomo woman with army worms, 2018

more stable and predictable food sources. The emergence of large-scale livestock production further displaced insects as a primary protein source, as the focus shifted toward meat, milk, and eggs (Shine, 2020).

Psychological and sociocultural factors also played a role in the decline of entomophagy in Western societies. The perception of insects as pests and carriers of diseases contributed to the general aversion towards insect consumption (Looy et al., 2014). Insects are often associated with negative connotations, such as filth and danger, further reinforcing the reluctance to consider them as food (Payne et al., 2016).

A conflicted relationship with insects

Insects are often associated with negative connotations in Western societies. They are commonly viewed as pests that cause damage to crops, homes, and the environment. A significant portion of entomological research funding and demand stems from the medical and agricultural sectors, which primarily focus on insects that transmit diseases or negatively impact crop yields and crop quality. The use of insecticides, such as DDT, and tools like fly swatters further reinforce this perception that insects are harmful. Although entomologists acknowledge the vast differences among insects and other arthropod species and actively advocate for education about their essential roles in ecosystems and agriculture, the lion's share of funding and emphasis is directed toward extermination and management (Looy, 2014).

The Western repulsion towards invertebrates encompasses the perception that these species are disgusting and generally unfit for human consumption, except under desperate conditions (Bukkens, 1997; DeFoliart, 1999). Nonetheless, insects have served as a crucial food source for nearly all human societies, and this tradition continues in the majority of non-Western cultures today (DeFoliart, 1999).

Popular television shows like the NBC game show, *Fear Factor* or more recently the "Spill Your Guts or Fill Your Guts" segment of *The Late Late Show with James Corden* have capitalized on this sentiment by forcing contestants to eat insects as part of their challenges. In one instance on



Figure 3: Crime Files: Disturbing the Pantry, from Ortho Home Defense, 2013



Figure 4: Will Ferrell eats ant yogurt, from The Late Late Show with James Corden, 2018



Figure 5: Wedding cake filled with worms and beetles, from Fear Factor, 2014

Fear Factor, contestants were forced to consume a wedding cake filled with worms, beetles, and alligator eyeballs (2014).

The origin of the negative attitude towards insects, both in general and as a potential food source for humans, remains a puzzle (Looy, 2014). Proponents of the “optimal foraging” theory argue that entomophagy might not have developed in Europe due to the relative difficulty of obtaining insects as food when easier options were abundant. However, edible insects are indeed present in these regions (Ramos-Elorduy, 2009), and researchers (Holt, 1885; 1967) noted the use of insects for food and medicinal purposes among peasants. Furthermore, there is evidence that the early Romans were familiar with entomophagy (Harris, 1985). Aristotle, the ancient Greek philosopher, wrote about the consumption of cicadas in his work “History of Animals” (Aristotle, n.d./1910) where he mentioned that the cicada nymphs were considered a delicacy. Despite this, it is still uncertain why insects became the subject of such aversion (Bennett & Zeleznik, 1991; Harris, 1985).

A small number of species, including certain wasps, bees, scorpions, and spiders, pose a genuine danger to humans. Even if not lethal, their stings can be quite painful, contributing to heightened fears and phobias around insects in the public mind (Berenbaum, 1995). It has been suggested that humans may be “biologically prepared” to fear these creatures as an adaptive response. Nonetheless, this still does not fully explain why attitudes in the West are more negative than in other parts of the world (Looy, 2014).

Benefits of consuming insects

Insects have been found to be a healthy and sustainable alternative to traditional animal-based foods due to their high nutrient contents. They are a good source of essential nutrients such as vitamin B12, iron, zinc, fibre, essential amino acids, omega-3 and omega-6 fatty acids, and antioxidants, which are important for maintaining a balanced and healthy diet (Rumpold & Schlüter, 2013). Edible insects have proven superior health benefits compared to traditional protein sources (Zhou et al., 2020).

Their consumption can be linked to the improvement and prevention of chronic diseases such as diabetes, cancer, and cardiovascular disease. The nutrients found in insects, including fibre and antioxidants, have been shown to reduce inflammation and oxidative stress in the body, which are important risk factors for chronic diseases (Bukkens, 1997).

Cricket protein powder has also been found to support the growth of probiotic bacteria in the gut, which can improve digestion and overall gut health (Stull et al., 2018). Termites have been found to contain high levels of manganese, which is important for bone health and energy production (Nakamura et al., 2020).

In addition to its health benefits, entomophagy offers a plethora of environmental benefits. As insects are cold-blooded, they have a relatively high feed conversion efficiency. Feed conversion ratios (how much feed is needed to produce a 1 kg increase in weight) vary greatly depending

on the species. According to the Food and Agricultural Organization, insects typically can convert 2 kg of feed into 1 kg of insect mass, whereas cattle require 8 kg of feed to produce 1 kg of body mass (Food and Agriculture Organization, 2013).

Insects emit fewer greenhouse gases, like methane, than traditional protein sources, such as cows or pigs. Moreover, insects release minimal amounts of substances like ammonia in their waste matter.

The rearing of insects for protein production results in a substantially lower requirement for water and land resources when compared to traditional protein sources. The present methods of traditional protein production have resulted in a rise in environmental degradation and deforestation, with over 70% of agricultural land globally being used for livestock production (Mateo-Sagasta et al., 2017).

Last, insects can also be fed on organic waste, like post-production food waste, which creates an opportunity to achieve circularity in the food value chain (Ojha et al., 2020). Companies including Chapul Farms in the US, and Better Origin in the UK have made it their mission to close the food loop by converting organic waste into high-value food and agricultural products (Better Origin, n.d.; Chapul Farms, n.d.).

FEED REQUIREMENTS PER KILOGRAM OF:



BEEF
10 KILOGRAMS



PORK
5 KILOGRAMS



CHICKEN
2.5 KILOGRAMS



CRICKETS
1.7 KILOGRAMS

WATER REQUIREMENTS PER KILOGRAM OF:



BEEF
2,500 GALLONS



PORK
800 GALLONS



CHICKEN
567 GALLONS



CRICKETS
1 GALLON

GREENHOUSE GAS EMISSIONS PER KILOGRAM OF:



BEEF
2.85 KILOGRAMS



PORK
1.13 KILOGRAMS



CHICKEN
0.3 KILOGRAMS



CRICKETS
0.001 KILOGRAMS

SPACE REQUIREMENTS PER KILOGRAM OF:



BEEF
200 SQUARE METERS



PORK
50 SQUARE METERS



CHICKEN
45 SQUARE METERS



CRICKETS
15 SQUARE METERS

Figure 6: Environmental benefits of insects, adapted from Laylin, 2016

State of entomophagy globally

The global entomophagy market is anticipated to reach a value of US\$ 65.3 billion by 2033, growing at a compound annual rate of 5.5% (P.M.R, 2023). The Asia-Pacific region, led by Thailand, China, and Vietnam, is the largest market, accounting for around 41% of the total revenue in 2019 (Mancini et al., 2022). Europe (UK, Netherlands, and France) and Latin America follow with 22% and 21% market shares, respectively. In terms of insect types, beetles dominate the market with around 30% of the market share in terms of revenue, followed by caterpillars and Hymenoptera (bees, wasps, and ants) (Mancini et al., 2022).

Southeast Asia has a long-standing tradition of insect consumption, with 150-200 different species of edible insects being consumed (van Huis et al., 2013). Startups within the region are capitalizing on the opportunity presented by both the local tradition of eating insects and the growing global demand for sustainable protein sources, as exemplified by companies like Thailand's Bug-solutely and Singapore's Insectta (Ping, 2021). In Singapore, the possibility of consuming insects may soon become a reality as the Singapore Food Agency (SFA) is currently seeking input from the food and animal feed industry on permitting insects for human consumption and livestock feed. The SFA has consulted guidelines from the European Union and countries including Australia, New Zealand, South Korea, and Thailand, which have already approved the consumption of specific insect species (Tan, 2022).

Africa is home to the richest diversity of edible insects, with over 500 species consumed (Niassy & Ekesi, 2017). The dominant insect-eating countries include the Democratic Republic of the Congo, Congo, Central African Republic, Cameroon, Uganda, Zambia, Zimbabwe, Nigeria, and South Africa (Niassy & Ekesi, 2017).

With 14 insect-based businesses already operating, the Australian insect industry is expected to grow into a AUD\$ 10 million industry annually within the next five years. To advance the industry, the Australian government is making active efforts to forge partnerships among First Nations Peoples, researchers, and industry professionals to co-develop First Nations-owned initiatives, incorporate native insect species into sustainable

farming practices, and produce accessible, delicious, and nutritious insect-based foods (Ponce-Reyes & Lessard, 2021). Circle Harvest, Australia's largest and most advanced insect protein farm and food manufacturing facility, supplies foods containing insect proteins as a key nutritional ingredient to supermarkets around the country, as well as over 1000 school cafeterias (Rolfe, 2022).

In Europe, the consumption of edible insects is still low and often seen as socially improper. The European Union classifies edible insects and insect-based products as novel foods, which require valid scientific assessments to ensure consumer safety. However, interest in insect-based products has been increasing in recent years due to the potential environmental, economic, and food security benefits that insects could offer (Mancini et al., 2022).

In the Middle East, Qatar has banned the import and sale of edible insects, citing concerns over food safety, public health, and Halal requirements (Arabian Business, 2023).

Overall, the state of entomophagy globally is characterized by a growing yet relatively small market, driven by the increasing awareness of the health and environmental benefits of consuming insects (P.M.R, 2023). The traditional consumption of insects remains in several regions. Challenges include limited automation, scarce localized research, and reluctant consumer attitudes, but with increased investment and collaboration, the edible insect industry has the potential to contribute to a more sustainable food system.

Entomophagy in the Canadian context

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Historical evidence

Entomophagy has been practiced by humans for thousands of years. While it is typically associated with tropical cultures, insects have been a part of the diet of people living in northern latitudes as well. In the early twentieth century, Tlicho people of the Northwest Territories, Canada, were known to eat warble fly larvae as a byproduct of their caribou hunting. These larvae were left in place to develop further before being eaten raw and were prized for their taste (Lesnik, 2019). However, the European explorers who encountered the larvae found them watery and tasteless, in contrast to the natives who enjoyed their taste greatly (Anderson, 1918).

In the Great Basin region, which includes parts of Nevada, Utah, California, Oregon, Wyoming, and Idaho, grasshoppers would sometimes arrive in large numbers and were collected by local natives for their high food energy. They were naturally salted and sundried, and their mass collection resulted in higher energy returns than hunting and processing wild game (Madsen, 1989; Madsen and Schmitt, 1998).

The 17-year cicada *Tibicen septemdecim* was the most common cicada consumed by Indigenous peoples in North America. Cicadas belonging to the genus *Magicicada*, *Okanagana*, and *Platypedia* were also consumed by these peoples to a lesser degree. The de-winged bodies of cicadas were roasted or fried to be used in soup and were sometimes dried and stored for later use (Dixon, 1905; Sutton, 1988).

First Nations people would collect swarms of locusts almost as if herding cattle, beating through bushes to drive them into a pit to collect them. Similarly, the Shoshone would beat the ground to drive grasshoppers from bushes into a hole to trap them. Once collected, the insects would be cooked and made into soup or turned into a paste. The Digger Indians used a similar method to gather the insects, setting surrounding grasses on fire until the insects were trapped and roasted. Afterwards, they were ground into flour-like powder and used to make small cakes (Berenbaum, 1994; Bodenheimer, 1951; Bryant, 1895).

The consumption of insects was a common practice within many diverse Indigenous communities across North America, however, Western cultures suppressed this practice when they began to interact with Indigenous peoples in the eighteenth and nineteenth centuries, considering it primitive behaviour (Food and Agriculture Organization, 2013). Colonialism appears to have initiated the decline of entomophagy in North America, with the spread of Western values and lifestyles contributing to the diminished practice. The growing adoption of Western habits, particularly in urban areas and among younger generations, is further exacerbating the reduction of entomophagy in regions beyond North America.

Recognition of insects as food

We launched into a multi-perspective inquiry on the current state of entomophagy within Canada. We examined the regulations and policies surrounding insects as human food and animal feed. Up until 2018, the only mention of insects on the Canadian Food Inspection Agency (CFIA) website was related to their presence in the food system as a contaminant. The regulatory bodies responsible for ensuring the safety and cleanliness of our food supply have primarily concentrated on preventing contamination, which has led to the natural exclusion of insects from our food system. However, on examination of both the archived “Guide to Food Safety” (2010) and the latest “Safe Food for Canadian Regulations” (2018) guide had no explicit mention of managing insects as it relates to food safety. In comparison, the regulations of the US Food and Drug Administration (FDA, 2021) outline the exact maximum limit of insect fragments permissible in various food items, which varies from peanut butter (30 fragments per 100g) to ground thyme (925 fragments per 10g) (US Food and Drug Administration 2018). This illustrates the impracticability of completely eliminating insects from the entire food production process, including the production, processing, and packaging of most foods.

It was only in 2018 that specific publications regarding the production, transformation, sale, and consumption of edible insects became available both within Canada and other interested regions

(U.S.A, Europe, Australia). The Canadian Food Inspection Agency published the results of its inquiry on the presence of microbacterial pathogens in commonly available edible insect products sold in various distribution channels throughout Canada in October of that year (Canadian Food Inspection Agency, 2018). In its report, the CFIA noted that while insects are safely and widely consumed in Africa, Asia, and Latin America, there is little scientific information available regarding the control of microbiological pathogens during the rearing and processing of edible insects. Nonetheless, the CFIA emphasized that edible insects produced for human consumption and available to Canadian consumers must meet the same safety and hygiene standards as other foods available in Canada (Canadian Food Inspection Agency, 2018).

The CFIA further reported that its experts found no evidence of contamination by salmonella or E. coli pathogens in the samples it collected. As a result, it concluded that the edible insects were produced under sanitary conditions. However, the CFIA stressed the need for a wider study and a closer look at stakeholders’ practices throughout the industry, as well as further research into the growing custom of insect consumption.

Government funding

The Government of Canada has allocated roughly CAD\$ 35-40 million in funding and grants to companies focusing on scaling up insect farming, establishing insect protein production facilities, and procuring equipment for food waste processing and insect protein production (Government of Canada, n.d.).

Several notable investments have been made including Aspire FG, which received CAD\$ 10 million from Sustainable Development Technologies Canada, followed by a CAD\$ 16.8 million investment through the NGEN Supercluster. This funding aims to develop high-tech automation for cricket processing facilities. Enterra secured a CAD\$ 6 million investment in January 2021 from the Government of Canada's AgriInnovate Program. Nutrento INC received CAD\$ 633,100 in December 2022 for purchasing equipment for food waste processing and insect protein production. Lastly, TriCycle was granted CAD\$ 400,000 in May 2022 to develop insect production technology for creating high-nutritional-value, low-environmental-impact food and generating beneficial by-products for vegetable crops. Several other grants of less than CAD\$ 50,000, have been made to fund research, development, and seed new ventures (Natural Products Canada, 2022). See Appendix E for specific details of Government of Canada funding.

Emergence of new businesses

In the past decade, the interest in insect protein as a sustainable alternative food source in Canada was spurred by the influential 2013 Food and Agricultural Organization report on entomophagy (Van Huis et al., 2013). This trend led to the emergence of multiple startups in Canada (Hutchins, 2017) although the precarity of the industry is evident. Some of the key players in this sector between 2013 and 2018 included: Entomo Farms, EXO, Entosystem, Näak, Fit Cricket Nutrition, One Hop Kitchen, Yes Crickets, Coast Protein, Midgard Insect Farm, Third Millennium Farming.

These examples highlight the initial growth and development of the insect protein industry in Canada. However, the sector was still in its infancy and many did not survive the various challenges the industry posed. Companies had to navigate regulatory hurdles, address consumer skepticism, and overcome logistical obstacles to establish a more sustainable protein industry in the country. Like any emerging sector, the insect-as-food industry stands to gain substantially from the adoption of advanced technologies, the establishment of prompt and transparent regulatory frameworks, widespread market acceptance, improved supply chain efficiencies, and dedicated research efforts (Natural Products Canada, 2022).



Figure 7: One Hop Kitchen pasta sauces, 2022



Figure 8: Yes Crickets dry roasted crickets, (n.d.)



Figure 9: Coast Protein cricket protein bar, 2017

Research

While investments play a vital role in the growth of the insect protein industry, there is a pressing need for continuous research and the involvement of trade associations to ensure progress. As Gabe Mott, COO of Aspire Foods, aptly states, “you look at another protein industry such as poultry where they’ve been doing research for over 50 years on every aspect of the process — diet, nutrition, disease, breeding — and they’re still doing research. In comparison, the insect industry is just getting started with its research efforts. There is a lot more research to be done to help us reach the level of production efficiencies that we need to make this industry a viable contributor to the global protein supply chain” (Natural Products Canada, 2022).

Canada has taken an active role in the research and development of insects as an alternative protein source. Over the past decade, the Canadian government has invested to support this burgeoning industry and advance its growth. Like any emerging industry, the insect protein sector experiences its own growing pains, which include learning about and improving the product, production processes, market opportunities, customer behaviour, and regulations (Government of Canada, n.d.).

Critical research areas for advancing the insect protein industry include understanding insect physiology, nutritional content, the impact of nutrient content on target feed consumers (fish, dogs, humans, etc.), optimal rearing conditions, and disease and health risks. Additionally, sustainable and cost-effective production practices

have been a primary focus, as one of the challenges faced by traditional feed industries is the cost and scale of insect production (Van Huis & Oonincx, 2022).

Trade organizations and initiatives like the North American Coalition for Insect Agriculture (NACIA) and Natural Products Canada play a significant role in promoting insect-based protein sources. These organizations aim to create a collaborative environment for stakeholders, including researchers, farmers, processors, and industry leaders, to share knowledge and resources. “Insects to Feed the World” is an initiative that originated from a 2014 conference of the same name, organized by the Food and Agriculture Organization of the United Nations, Wageningen University, and other partners. The initiative seeks to address global food security and sustainability challenges by promoting insects as a sustainable and nutritious protein source for both human consumption and animal feed (Natural Products Canada, 2022).

In Canada, Université Laval is actively involved in research areas related to insects as food and feed, having recently introduced a chair of leadership in teaching the production and processing of edible insects (Titulaire de la chaire de leadership en enseignement en production et transformation primaire d’insectes comestibles). Université Laval hosted the international “Insects to Feed the World” conference in 2020 and 2022, attracting hundreds of insect researchers and enthusiasts worldwide.

Conspiracy theories

With a growing global general mistrust in public institutions, a new conspiracy theory claiming that the global elites are trying to force individuals to eat insects to save the environment has begun to gain traction in Canada (Butler, 2022). This idea sprouted from the World Economic Forum's annual meeting in Davos and is linked to the greater conspiracy of the "Great Reset" — what is described as the global reorganization of society.

This conspiracy has gained further momentum through popular American far-right media personalities including Tucker Carlson and Steve Bannon. Tucker Carlson believes that beyond being forced to eat insects, it is also a threat to identity stating that "Eating insects is repulsive and un-American" (Jingnan, 2023). Steve Bannon refutes the idea of being forced to eat insects and claims this is just one way the "Great Reset" is being enacted. The conspiracy has been amplified by sensationalist media outlets like Fox News, which has a history of capitalizing on controversy to boost television rating points. By playing on the "repulsive" aspect of eating insects and the so-called impact on national identity, they cater to the audience's fears. Instead of promoting a neutral discussion, this approach only exacerbates the controversy.

Meanwhile, in Canada, an article published in the Alberta-based *Western Standard* makes similar claims (Selick, 2022). The article references the World Economic Forum's video which states that by 2030, people will eat much less meat for

the good of the environment and their own health. The article also references "97 fires [that have] damaged or destroyed food processing plants in the US since Biden took office," then claiming these fires are deliberate "as tyrants around the world take steps to render populations more dependent than ever on government for their very survival." The article also claims that "normalization propaganda" is being prepared in an attempt to force Canadians to eat insects.

The comments on a recent post in *r/Canada* on Reddit, demonstrate how mainstream this conspiracy has become. One comment asks "So...is the whole "they want us to eat bugs" conspiracy real!?" Responses include "The only difference between a conspiracy theory and reality these days is about six months" and "Black rock and foreign millionaires took your homes. The Gov took your guns. Carbon taxes took your car to subsidize the rich who can afford EV. 500k goal of immigration took your wage growth. WEF will force feed you bugs by making everything else unaffordable. YET, they wonder why there are too many right wing extremists now. They are proving the conspiracists everytime." Other comments include "i will eat the rich before i will ever eat bugs" and "I will never willingly or consciously eat insects as a food source. Anyone pushing this agenda can just fuck off and die" (benfelix1, 2022).

Iterative Inquiry

The objective of conducting the Iterative Inquiry was to understand the system boundaries defining the commercialization of insects and to analyze the commercialization process and its effects on the food industry and society.

We evaluated the industry through the lens of economic viability, environmental sustainability, health and safety, cultural acceptance, and regulatory compliance. We further examined various subsystems of the commercialization process, including insect farming and processing, insect-based food products, regulatory environment, consumer attitudes and perceptions, and environmental impact.

The boundary assumptions that underlie the critique include the belief that insects are a viable alternative protein source, that the commercialization process is both customer and market-driven and that public perceptions about insect consumption are changing.

The Iterative Inquiry highlights the need for clear regulations and policies to ensure safety, labelling, certification, and market access for insect-based products. Additionally, the inquiry highlights the importance of addressing consumer attitudes and perceptions towards insect-based products, as well as the environmental impact of insect farming and processing.

	<i>Function</i>	<i>Structure</i>	<i>Process</i>	<i>Purpose</i>
<i>Consumer</i>	To rethink eating habits and access nutritious and sustainable foods	Health and environment conscious consumers, adventurous consumers, retail/online stores, restaurants, food events, insect products, educational resources, consumer feedback, delivery services	Education, self-reflection on eating habits, experimenting with new foods, understanding sustainability and nutrition, advocating for affordable, tasty, sustainable, and healthy options	Diversification of protein sources, food security
<i>Entomophagy evangelists</i>	To raise awareness and shape consumer behaviour; showcase insect product versatility and culinary appeal	Influencers, restaurants, chefs, food events, premium insect produce/products, recipes, and related expertise	Education, product development, supply-chain optimization, menu creation, customer engagement, and marketing/promotion	Environmental sustainability, and cultural and culinary diversity
<i>Insect processors</i>	To source insect ingredients and transform them into value-added, consumer-ready products tailored to meet consumer needs and preferences	Entrepreneurs, investors, food scientists, marketing teams, processing facilities, R&D labs, retail outlets, online platforms, packaging materials, and regulatory certifications	Partnering with reliable insect producers, product innovation and testing, regulatory compliance, marketing/promotion, supply-chain, customer support	Growing alternative protein market and addressing the evolving demands and preferences of consumers
<i>Insect producers</i>	To produce high-quality, environmentally-friendly, and economically viable insect proteins to support innovation and growth within the industry	Investors, industry associations, supply-chain partners, researchers, production facilities, equipment and technology, new insect species, insect feed and water access	R&D, regulatory compliance, sustainable production, supply-chain management, networking, partnerships, workforce development, funding access	Addressing Canada's food system challenges and meeting the demands of the population
<i>Government of Canada</i>	To ensure the safety, health, and sustainability of the food supply chain while supporting economic growth and innovation	Policymakers, regulators, researchers, scientists, research institutions, universities, infrastructure, technology, trade partnerships	Food safety regulations, R&D support, financial & risk management, environmental stewardship, market access, trade promotion, consumer education, ongoing evaluation	A well-functioning, sustainable, and economically viable food system that can meet the needs of the population and contribute to global food security

Figure 10: Iterative Inquiry

Stakeholder map

We built a detailed stakeholder map that illustrates the relationships and alliances between various actors, along with the potential drivers and barriers to change in the industry. The premise of the map is the commercialization of insects as a source of protein. As our comprehension of the industry evolved, we continually refined the stakeholder map to reflect new learnings.

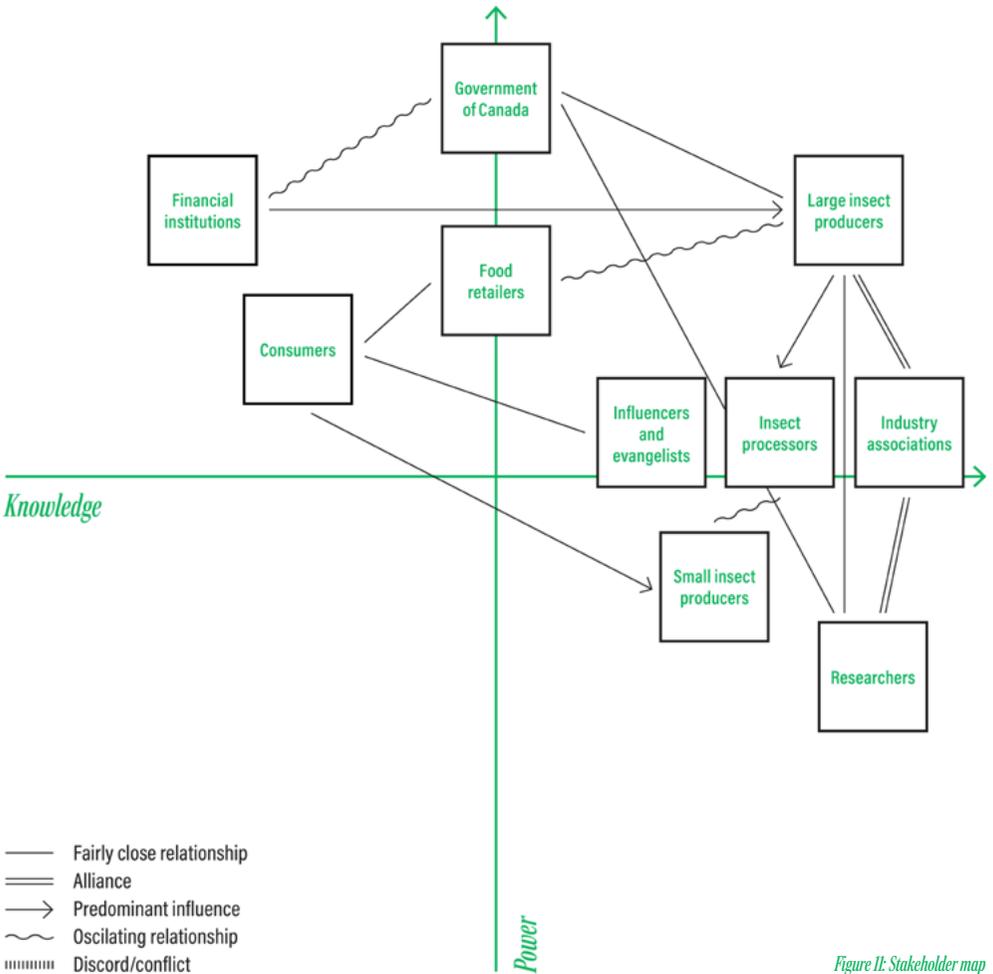


Figure 11: Stakeholder map

At the top of the power dynamic hierarchy is the Government of Canada, which has the most power and influence over the commercialization process. While they play an important role in regulating the safety and quality of insect-based food products, they have limited direct influence over consumer behaviour or the development of the entomophagy market.

The consumer, on the other hand, has low knowledge but medium-high power and is a key actor in driving demand for insect-based products, which in turn shapes the direction of the market. However, their low knowledge of the industry may limit their ability to make informed choices about insect-based products.

Researchers have high knowledge but lower power and can play an important role in providing scientific evidence and insights to inform policy and industry practices. They can also help to address knowledge gaps and dispel misconceptions about the safety and nutritional value of insects as a food source. However, their academic work may be inaccessible to the general population or to industry stakeholders, especially if framed in theoretical terms.

Insect protein producers and processors play a key role in producing and marketing insect-based products, making them more widely available to consumers. Through our research, we identified the existence of both small and large insect producers. Small insect producers generally have limited production capacity, focusing on local or regional markets, whereas large insect producers have the capability to serve larger markets, both domestically and internationally. Large insect producers typically have access to greater financial, technological, and human resources compared to small producers. This allows them to invest in advanced production facilities, research and development, and marketing strategies to expand their reach and influence. Large insect producers often wield high power in shaping industry standards, regulations, and best practices and have more access to knowledge and expertise, better enabling them to evolve the industry. We believe both play a crucial role in the evolution of the industry where small producers can contribute to the industry's grassroots growth and promote local acceptance, large producers can drive innovation and expand the market for insect-based products on a broader scale.

Industry associations like North American Coalition for Insect Agriculture (NACIA) have the ability to raise public awareness about the environmental benefits of consuming alternate protein sources and support businesses in the space through research and networks. However, they might have limited direct influence over government policies or business practices.

Food retailers can play a role in promoting and normalizing insect-based dishes to consumers. By offering specific menu items, they can drive demand for certain ingredients or food products. Restaurants can also serve as testing grounds for new food products and help popularize them. Grocery stores play a vital role as they are a primary point of contact between consumers and various food products. When grocery stores stock insect-based products and feature them prominently, they provide visibility and credibility to these alternative protein sources. By placing these products alongside traditional protein options, grocery stores help normalize insect consumption and facilitate consumer exposure to these new food choices. Grocery stores can also contribute to consumer education by hosting in-store tastings and offering cooking demonstrations featuring insect-based dishes. These activities can help to demystify entomophagy and address concerns about taste, preparation, and nutritional value.

Food influencers and evangelists can play a role in promoting awareness and interest in insect-based products. They can influence their followers through their recommendations and purchasing decisions, leading to increased demand for certain foods or food brands.

The commercialization of insects as a protein source depends on the collective efforts of all these actors. The growth and sustainability of the industry can be significantly enhanced through collaboration and strategic alliances among these stakeholders. For instance, researchers can work closely with insect protein producers and processors to develop innovative technologies and practices, while industry associations can partner with the government to create supportive policies and raise public awareness about the benefits of entomophagy. Restaurants and chefs can collaborate with food influencers to promote and normalize insect-based dishes, thereby increasing consumer acceptance and driving market demand. By leveraging uncommon collaborations, and the expertise of each stakeholder, the entomophagy industry can contribute to a more sustainable and resilient food

system. A potential collaboration strategy could involve enhancing partnerships between researchers and insect protein producers to advance production technologies and industry best practices. Next, it is important to solidify connections between industry associations and government agencies to establish supportive policies, regulations, and funding opportunities. Finally, implementing educational and marketing campaigns can help raise public awareness, reduce stigma, and foster a receptive market for entomophagy in Canada.

See Appendix F for a deeper dive into the roles of these stakeholders.

Canadians' insect consumption patterns

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Values, consumption habits, and attitudes

The acceptance of entomophagy has gained momentum in certain social groups, but insect consumption remains widely uncommon. While previous studies have looked at the acceptance level of Canadians' insect consumption (Barton et al., 2020; Hénault-Ethier et. al, 2020), our survey sought to comprehend the motivations and barriers that drive Canadians' behaviour. To do so, our survey was structured into four sections: General Consumption Behaviour, Alternative Protein Consumption, Insect Consumption Behaviour, and Demographics. The General Consumption Behaviour section asked individuals about their dietary preferences, how they find information about new food products, and what characteristics — such as price, taste, and animal welfare — matter most to them. The Alternative Protein Consumption section asked respondents how often they consume other alternative proteins including plant-based meat, algae, plant protein, and others. This section allowed us to understand how the regularity of insect consumption may differ from other alternative proteins. The Insect Consumption Behaviour section began by asking if and how often respondents have consumed insects. It also asked participants how closely they were reflected in a series of 38 statements. The final section, Demographics, captured information such as age, cultural background, and geographic location so we could identify any patterns in responses.

The key findings from the survey are summarized below. To view the full survey questions, see Appendix C.

Environment is not top of mind

Although consuming insects has many environmental advantages, their significance is often overlooked by consumers in the context of food purchases. According to our survey findings, taste, health, and cost are the primary factors that influence consumer decisions across most demographics.

When purchasing food, what is most important to you?

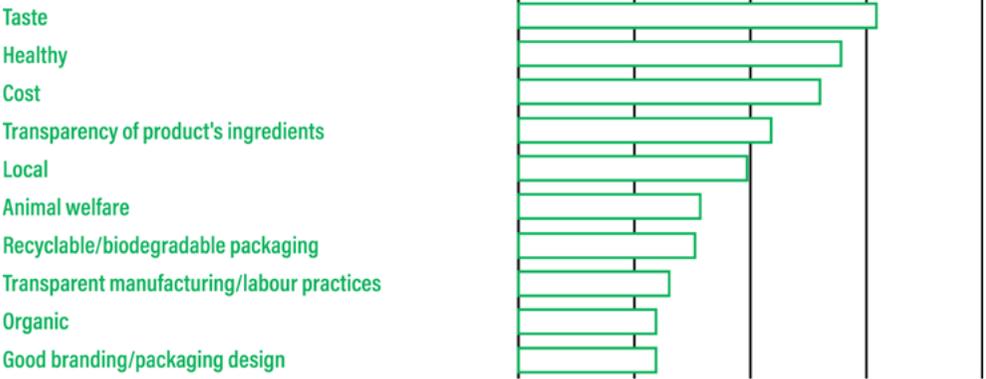


Figure 12: Environment is not top of mind

Are insects vegan?

Despite insects belonging to the kingdom *Animalia*, some vegetarians and vegans do not see insects as animals and choose to consume insects. Further, individuals who are vegetarian or vegan for environmental or health reasons, tend to be more open to entomophagy (House, 2016). Of the 25 respondents who claimed they were presently vegan or vegetarian, eight responded that they had consumed an insect before.

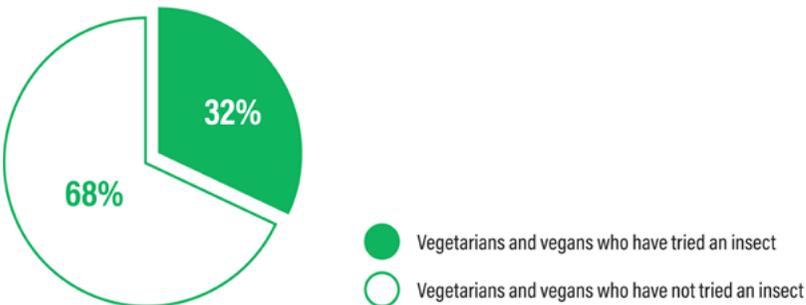
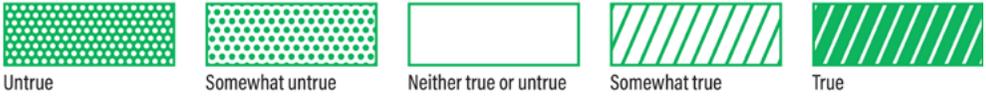


Figure 13: Are insects vegan?



Consuming insects has benefits

When asked about entomophagy’s benefits for consumers and the environment, respondents demonstrated a clear understanding of the varied benefits of eating insects.



Figure 14: Consuming insects has benefits

Insects are safe

Consumers understand that eating insects is safe and sanitary.



Figure 15: Insects are safe

Trust in restaurants

Our findings show that consumers are more willing to try insects in a restaurant setting, possibly due to perceived safety standards or trust in preparation.



Figure 16: Trust in restaurants

More information is needed

While it is true that consumers are aware of the advantages of consuming insects and perceive it as a safe practice, they express a desire for more information.

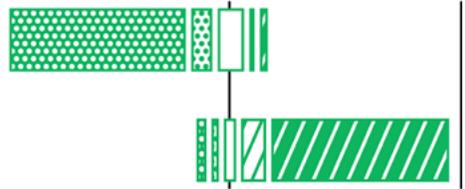
I would be more open to eating insects if I had more information



Figure 17: More information is needed

Even though we could not clarify what other information consumers wanted based on the format of the survey, it is clear that there is a lack of overall understanding of the practice including how to prepare insects. This could be expanded in a future research project.

Eating insects feels familiar to me



I do not know how to prepare insects

Figure 18: Unknowledgeable about entomophagy

Willing to try

Like much of the current research (Barton et al., 2020; Hénault-Ethier et. al, 2020), our survey results confirm that many Canadians are open to the idea of consuming insects.

If my friends or family were eating insects, I would eat them too

If insects were locally available to me, I would be more likely to purchase them

I would be more likely to try eating insects, if I lived in a region where it is more common

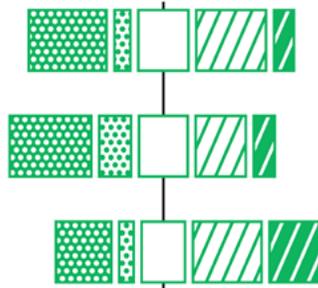


Figure 19: Willing to try

Our findings suggest that males, aged 18-34 are the most open to consuming insects.

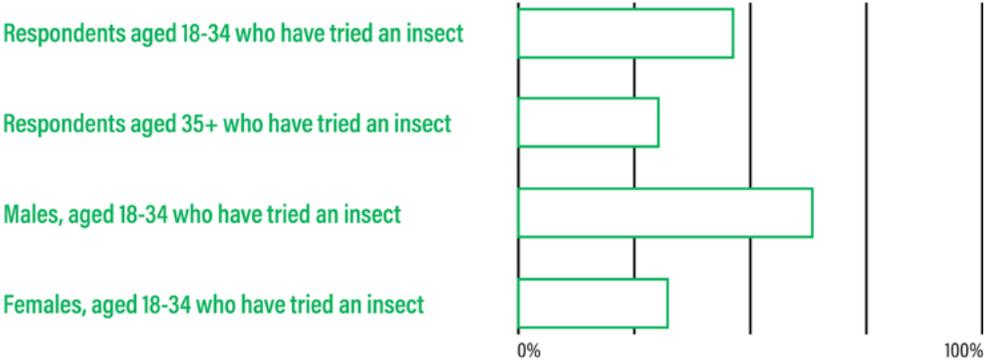


Figure 20: Most open demographic

Insects are gross

The disgust factor is still prevalent with some consumers. While some consumers find the overall practice of eating insects disgusting, others find specific aspects off-putting.

Eating insects is disgusting



Figure 21: Eating insects is disgusting

Some consumers claim that insects would be more appealing if they were used as an ingredient and hidden in other foods.

Insects would be more appealing if they were hidden in other foods



Figure 22: Insects are more appealing when hidden

Others find the names of edible insects including crickets and mealworms disgusting.

The names of edible insects (crickets, mealworms) are disgusting



Figure 23: The names of insects are disgusting

Promotion of entomophagy

To better understand the current state of the entomophagy industry in North America, we conducted semi-structured interviews. The primary objectives of these interviews were two-fold: to ascertain the difficulties facing business owners and other stakeholders within the system, and to assess the efficacy of the promotional techniques employed by companies to encourage the continued consumption of insects. We also compared these interview findings with existing literature.

Through our research, it is clear that the primary strategies to convince Canadians to start consuming insects currently are to emphasize the environmental and health benefits. These strategies are rational and utilitarian and while these rational benefits are helpful, they are unlikely to provide enough motivation to drive behavioural change. Researchers propose that instead of relying on rational discourse, a shift to hedonic strategies may be more effective (Berger et al., 2018; Deroy et al., 2015; Shine, 2020). Hedonic strategies call for a focus on the emotional experience of food, including presentation and taste.

Some companies have started to experiment with strategies beyond touting the environmental and health benefits, but there is little understanding of their effectiveness. These strategies include the use of insect imagery, celebrities and influencers, and non-common names. As the industry in Canada is still in its infancy, companies are trying a variety of techniques to see what resonates with consumers.

To supplement our interview data, we also conducted a brand analysis using tactical comparison. In this process, we looked at the packaging, social media, and websites of ten companies that represent a cross-section of the entomophagy industry in Canada.

	Promotion of environmental benefits	Promotion of health benefits	Use of insects as an ingredient	Use of insect imagery	Use of influencers	Use of non-common names
Actually Foods	●	●	●			
Näak	●	●	●		●	
La Mexicoise	●	●	○	●		
Grillon Le Pain	●	●	●	●		
Landish	●	●				
Mélio Food	●	●	●	●		
Earthproof Protein	●	●	●			
Ever-Food	●	●	●			
Entomo Protéine	●	●	○			
Insects Intrinsic	●	●	○	●		

○ Some products sold insects as an ingredient

Figure 24: Brand analysis of promotional strategies

Environmental benefits

One of the primary promotional strategies is lauding the environmental benefits of insect production. This strategy has been widely used since the release of the Food and Agriculture Organization’s report, “Edible insects: future prospects for food and feed security” (2013). As described in this report, consuming insects has several advantages including a high feed-conversion efficiency (an animal’s capacity to convert feed mass into increased body mass); that they can be reared on organic side streams, reducing environmental contamination, while adding value to waste; they emit relatively few GHGs and relatively little ammonia; and they require significantly less water than cattle rearing. Although the majority of entomophagy companies mention the environmental benefits, the level at which it is promoted varies.



Figure 25: Environmental impact of cricket vs. beef, from Nääk. (n.d.)



Figure 26: Environmental benefits of cricket powder, from Entomo Farms, (n.d.)

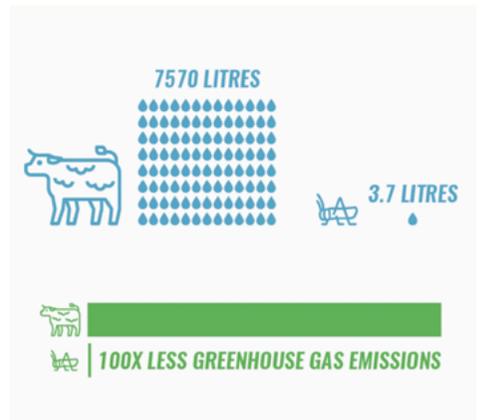


Figure 27: Water usage and GHG emissions, from Earthproof Protein, (n.d.)

As we look at a cross-section of the claims made by different entomophagy brands in Canada, we see the claims are vastly different. This disparity has also been identified by Berger et al., 2018, and Lundy & Parella, 2015, and raises questions about the validity of the claims due to the lack of cited evidence.

Health benefits

Another of the primary strategies is based on the nutritional benefits of consuming insects. These benefits differ depending on the species of insect as well as the metamorphic stage of the insect (Food and Agriculture Organization, 2013). Generally speaking however, insects offer a multitude of nutritional benefits including high levels of vitamin B12, iron, zinc, fibre, essential amino acids, omega-3 and omega-6 fatty acids, and antioxidants (Nowakowski et al., 2021). Due to this range of benefits, companies and media across North America are considering insects as a new “superfood” (Haiken, 2014; Gill, 2016; Prior, 2019). In Canada, a large part of current product development is protein-rich products.

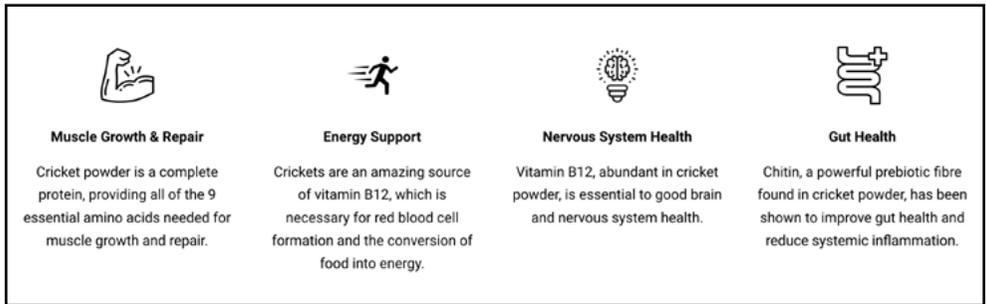


Figure 28: Health benefits of cricket powder, from Landish, (n.d.)

Insects as an ingredient

After being reared and harvested, insects can be processed in three ways: whole, ground into a paste or powder, and as an extract of protein, fat, or chitin to fortify other foods (Food and Agriculture Organization, 2013). To increase acceptability among Canadian consumers, many brands use insects as an ingredient in common food forms. Over the past ten years, brands (some of which have since ceased operations) have experimented with commercializing a variety of products with insects as an ingredient including One Hop Kitchen, a Canadian brand that

launched pasta sauces with crickets and mealworms; Aldento, a Belgium-based company that sells pasta enriched with mealworms; and FUNA foods, a US-based brand that makes a ground beef alternative using cricket powder. In Canada, the use of cricket powder is preferred with up to 20% of a product coming from the powder (Reverberi, 2021).



Figure 29: Cheddar Cheese Puffs, from Actually Foods, (n.d.)



Figure 30: Cricket-based spaghetti, from Voyou, (n.d.)

Though this strategy may reduce the aversion in some consumers, it reduces insects to be used solely for their nutritional value.



Figure 31: Cricket-based buns, from Grillon Le Pain Crickbread, 2020

Beauty benefits

Insects are known to be a rich source of proteins, containing all 9 essential amino acids for human body growth, vitamins, and minerals, which can contribute to the overall health and well-being of an individual. In particular, they are high in nutrients like biotin, zinc, and vitamin B-complex, which are crucial for maintaining the health and appearance of skin, hair, and nails (Rumpold & Schlüter, 2013)

Biotin, also known as vitamin H, is essential for maintaining healthy skin and hair, as it plays a role in the synthesis of keratin – the primary structural protein found in hair and nails. Zinc is another vital nutrient that supports skin health by aiding in cell regeneration and collagen production, which helps maintain skin elasticity and reduces signs of aging. Additionally, vitamin B-complex contributes to skin health by promoting proper cell function and reducing inflammation (Oregon State University, 2021).

Brands like Human Improvement (Hi!) are capitalizing on these benefits by offering insect protein products to health-conscious consumers (Human Improvement, n.d.).

Celebrity endorsements

Celebrities and influencers have been increasingly used in “campaigns for food and beverage products to induce positive consumer responses for the products advertised” (Park et al., 2022). Brands like Nääk, a brand whose goal is to build the most efficient and sustainable fuel for endurance sports through cricket protein, have built a community of sponsored professional athletes (Nääk, n.d.). Images of these athletes fill Nääk’s social media accounts with the implied message that you too can be an elite athlete if you consume Nääk products.

Celebrities can also bring widespread attention to their followers, although this attention could lead to both negative and positive responses.

Questlove, an American musician, posted a photo on his food-focused account, in 2015 eating a dish topped with crickets. The caption read: “This was not a dare....@questlove is eating crickets and they are delicious.” The post received comments including “If eating crickets make you this happy—then I’m down to try it!” and “You are a brave man!!” (Quest Loves Food, 2015).

Use of insect imagery

The use of insect imagery on packaging or promotional activities can be categorized into two segments. The first segment are brands that want to reduce the disgust factor by hiding all imagery of insects and often use insects as an ingredient in their products. The second segment includes brands that want to play off of the novelty factor of insect consumption and use insect imagery. These brands typically sell more whole insect products.



Figure 33: Cheddar Jalapeño Puffs, from Actually Foods, (n.d.)



Figure 34: Don Grillo: Roasted Crickets, from La Mexicoise, 2020

Not using common names

To address some consumers' aversion to insects based on their common names, some companies have started to market cricket protein as Acheta (EXO, n.d.). This strategy has been successfully used with other products including the Chilean sea bass, formerly known as the Patagonia toothfish and the kiwifruit, formerly known as the Chinese gooseberry (Richter, 2011).



Figure 35: Fudge Brownie Protein Bar, from EXO, (n.d.)

Rethinking approaches

As demonstrated in the previous section, companies have implemented various strategies and tactics to increase consumption to varying degrees. Although these strategies have been successful in increasing the acceptability and trialability of insects, these strategies have yet to trigger wider behavioural change. In our context, we see behavioural change as going beyond the acceptance of insect-based food and products. We aim to foster the development of habits that seamlessly integrate these foods into consumers' everyday diets, making them a regular and natural part of their meal choices.

Further, we see that the first trial is not necessarily leading to repeated consumption. During an initial tasting, individuals are often surprised by the taste and are interested in adding insects to their diets. This initial excitement and motivation to continue eating insects often wanes over time as consumers face obstacles. Some of these obstacles include the availability of insect-based products, the variety of products available, and the cost of the products. Overcoming these challenges is not a straightforward task, as the entomophagy industry, particularly in Western societies, remains in its early stages of development. Food habits have been ingrained in cultures and societies for centuries. Changing these habits will require several iterations and adoption of new strategies. The subsequent chapters will explore the requisite changes, current consumer behaviours, and possible interventions to facilitate the transition toward regular insect consumption.

What needs to change?

While our research identifies behavioural change as central to achieving greater insect consumption, we have identified other problem areas that must be addressed to support this shift. These areas were identified through our interviews with stakeholders in the entomophagy industry.

Supply of high-quality insects

With the growth of the entomophagy industry in Canada, some end product producing businesses are having trouble securing a stable supply of high-quality insects. The industry comprises a majority of companies that process insects into a final product, resulting in a high degree of reliance on producers of mini-live-stock (insect farmers). Only a few companies rear insects and process them into a final product. The unstable supply of insects necessitates constant adaptation to new batches of raw unprocessed insects, which often vary in size and flavour profile. The lack of a steady supply chain can lead to decreased revenue for processors and greater accessibility issues for consumers.

Furthermore, the unsteady supply of insects has resulted in fluctuations in the pricing of raw, unprocessed insects, posing challenges for business planning and potentially leading to increased costs passed on to consumers. As described by one of our interview participants, many businesses have turned to importing insects from Southeast Asia to circumvent this issue, providing a more secure supply chain. However, this approach raises concerns regarding safety standards, increased environmental impact through shipping, and a higher likelihood of biosecurity risks.

Increased competition

The growth of the entomophagy industry in Canada will naturally lead to an increased awareness of the value of consuming insects. Increased competition will eventually lead to lower prices, which would increase accessibility. Competition is also a key driver of innovation. As more companies enter the Canadian market, they may be forced to create products that are more suited to the needs of consumers.

Greater access for consumers

One of the challenges with achieving widespread consumption in Canada is the lack of availability of insect products. When individuals try an insect for the first time, their motivation for continuing to consume insects is fairly high, but this motivation often diminishes as it becomes challenging to access products. Access is also highly dependent on the market, too. For example, in larger markets like Toronto, Ontario, insect products are much more available in stores versus a smaller market like St. Paul, Alberta. By increasing the visibility of insect products in stores, the consumption of insects may become further normalized and individuals may feel nudged to purchase these products. It is challenging for small businesses to get valuable shelf space in grocery stores, especially when the demand is relatively low compared to traditional protein products.

Growth in research

Currently, two species have become commercialized for human consumption within North America and Europe: mealworms and crickets. As there are thousands of edible insect species, researchers could investigate whether other species could become commercially reared. This would allow for a greater variety of insect products and therefore different flavour profiles and consumption experiences.

Another area where research is needed is rearing processes and perhaps the further integration of automation. New rearing techniques could lead to a more localized product, increased yield, and reduced costs.

Growth in intra-industry collaboration

As the entomophagy industry is still growing in Canada, collaboration is essential. Industry associations and businesses can share resources, expertise, and knowledge to accelerate research and development, develop coordinated messaging campaigns, optimize supply chains, and advocate for policies that support the continued growth of the industry.

Understanding the system

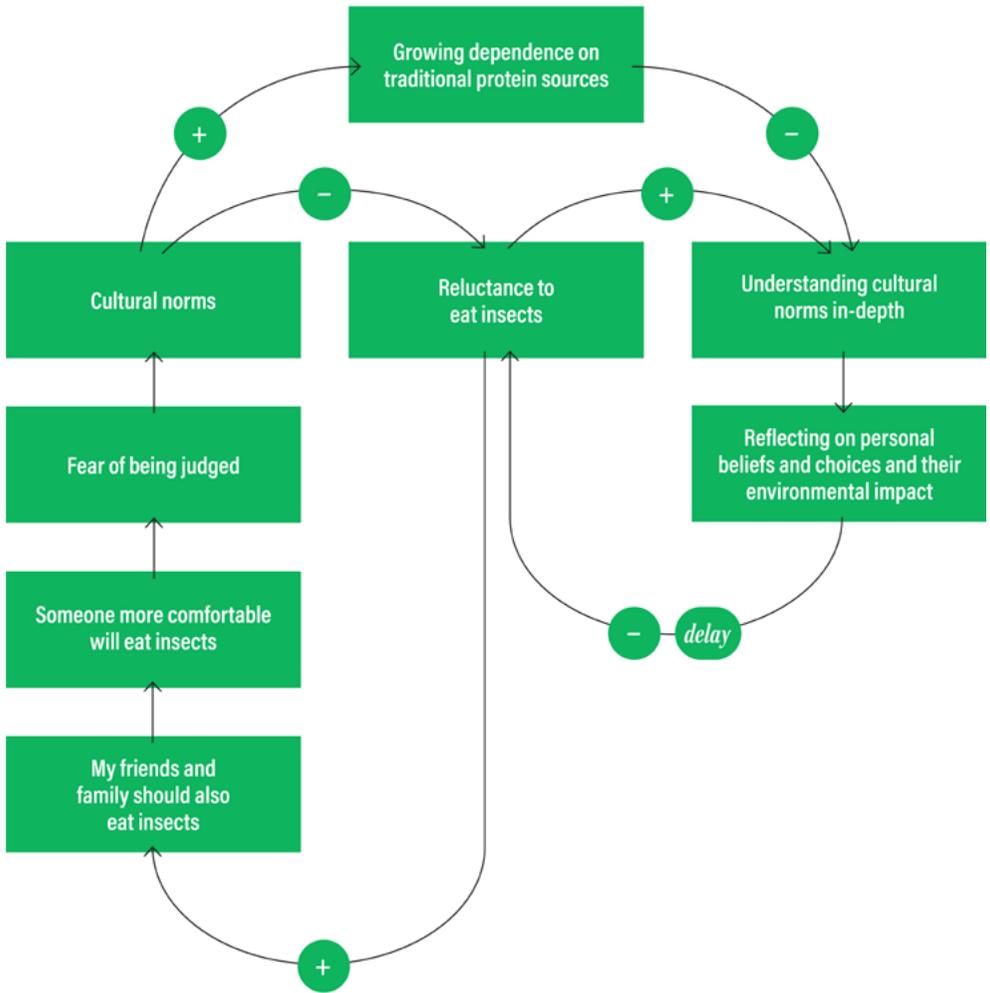
Based on the insights gained from our survey, the pattern of behaviour observed could potentially fit into the "Shifting the Burden" archetype. In this archetype, there is a fundamental problem that needs to be addressed, but instead of directly tackling the root cause of the problem, people rely on a symptomatic solution that provides temporary relief (Kim, 1994).

Although a significant portion of respondents acknowledge the potential benefits of insect consumption, they are still reluctant to consume insects due to factors such as cultural norms, personal attitudes, and fear of being judged. This suggests that while there is awareness about the potential of insects as an alternative protein source, there may be underlying factors that prevent people from adopting this change.

Specifically, the fact that the majority of respondents think that eating insects promotes environmental sustainability suggests that Canadians are open to the idea of insect consumption. However, their hesitancy to try insects can be attributed to a lack of familiarity with insect-based foods or a fear of being perceived negatively by others.

Similarly, the fact that a portion of respondents across all age groups finds the idea of eating insects disgusting or unappetizing suggests that there may be a need for education and awareness campaigns to shift perceptions around insects as a food source.

The "Shifting the Burden" archetype observed through our research reveals that while respondents recognize the environmental benefits of insect consumption, underlying factors such as cultural norms, personal attitudes, and fear of judgment prevent its adoption.



- + Positive causal link
- Negative causal link

Figure 36: *Shifting the Burden*

Facilitating behavioural change

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Promoting the acceptance and appreciation of entomophagy in the Western world has primarily been approached as a rational issue, addressed through education (Looy et al., 2014). While these endeavours have increased awareness of entomophagy, they seem to have had limited success in genuinely changing attitudes (Looy et al., 2014). This is because attitudes are not solely rational constructs but also possess emotional and cultural components. In order to be effective, solutions need to tackle all of these facets and the underlying values that influence them (Clark, 1995; McKenzie-Mohr & Oskamp, 1995).

An ingrained aversion to insects also obscures the presence and worth of those that consume insects, often being perceived as “primitive, barbaric, or desperate” (Forsyth, 1994). Embracing the idea of entomophagy means accepting the shared humanity of people from diverse backgrounds, social classes, races, and cultures. Only when we can truly appreciate and respect these differences can we fully understand and address the negative impact of Western food preferences, which continue to shape global food choices

Recognizing the potential of insects for human consumption and valuing old and new knowledge can only be achieved through a willingness to examine some of our most deeply-held and unconscious assumptions about food and consumption. The primary influence on food preferences stems from the social environment (Larson & Story, 2009). For example, in the family household, adults offer food to children and demonstrate and teach them what, when, and how to eat. If adults could be persuaded of the benefits of entomophagy, they could significantly impact the next generation's perception of insect-based foods as a normal part of their diet. However, this should be done in a clear, acceptable, and systematic manner. Repeated exposure to new foods helps develop preferences, and positive prior experiences with novel foods enhance the willingness to try new items (Loewen & Pliner, 1999; Pliner, 1982).

As such, behavioural change is critical for the acceptance of insects as a protein source and inclusion in diets because it addresses cultural, psychological and practical barriers that prevent the widespread adoption of insect-based foods. By altering perceptions, raising awareness, and creating an environment that supports the consumption of insect-based foods, behavioural change strategies can help pave the way for a more sustainable and nutritionally diverse food system.

Who has the power to make change?

Before we can develop behavioural change strategies, we need to understand who has the power to make change. We developed an influence map which highlights the priorities and motives of key stakeholders in relation to their decision-making power. The influence map is a derivative of the previous stakeholder map included in this document, but goes a step further to analyze priorities and the structure of the system, and to map out the influences. These were some of our observations from the exercise:

Government of Canada

With priorities centered around food safety, consumer protection, and the development of sustainable food policies, the government holds considerable power and is most influential in regulating the industry and setting standards for insect-based food products.

Consumers

Focused on health, taste, and affordability, consumers have the power to drive demand for insect-based products, shaping the direction of the market and influencing industry growth.

Insect producers and processors

Prioritizing market demand, economic viability, and customer satisfaction, these stakeholders play a crucial role in the production and marketing of insect-based products, making them more accessible to consumers.

Industry associations

By emphasizing collaboration, knowledge sharing, and industry growth, these organizations can help foster partnerships, facilitate research, and raise public awareness about the environmental and nutritional benefits of insect protein.

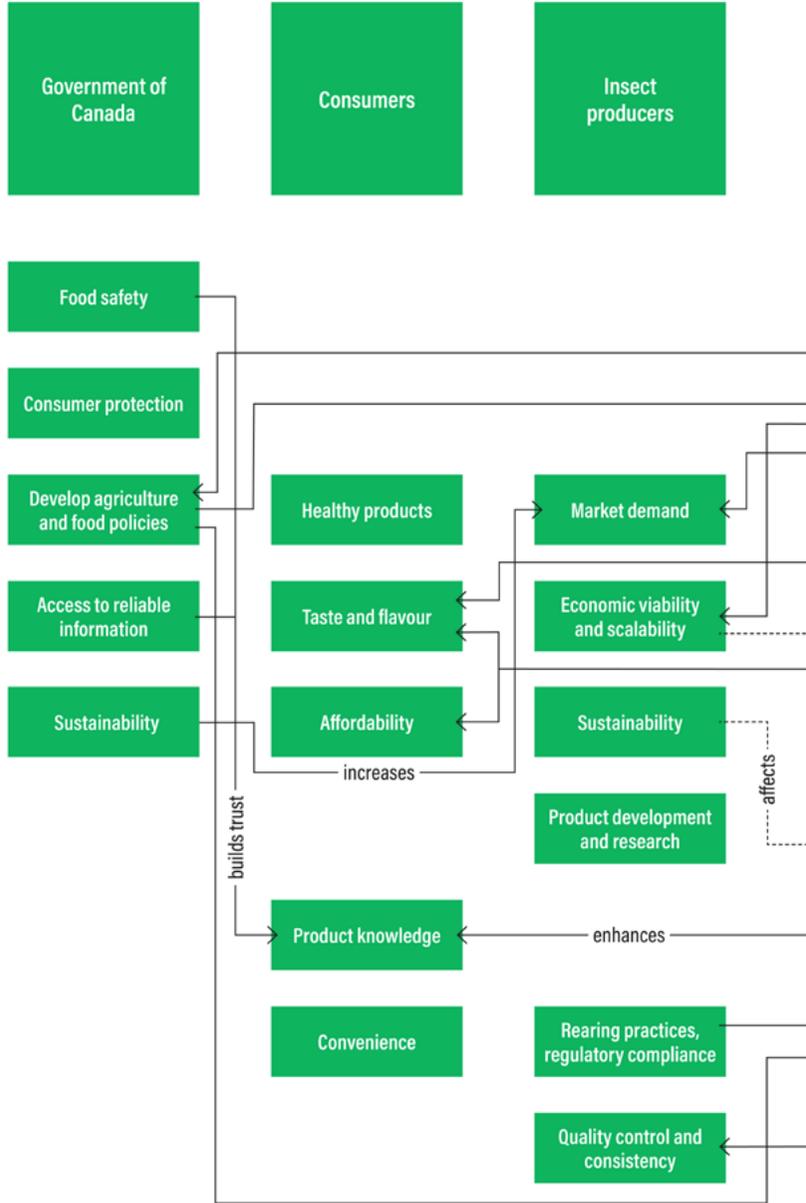
Food retailers

By offering insect-based dishes and products that cater to customer demands, these establishments can promote the normalization of insect consumption and drive demand for specific ingredients or food items.

We believe, as we have highlighted throughout this report, to successfully commercialize insects as a protein source, it is essential for these stakeholders to work together. The growth and sustainability of the industry can be significantly enhanced through collaboration and strategic partnerships among these actors, leveraging their respective expertise and resources to drive increased acceptance and adoption of insect-based foods.



Influence ↑



- One-way influence
- ↔ Two-way influence
- Indirect/weak influence

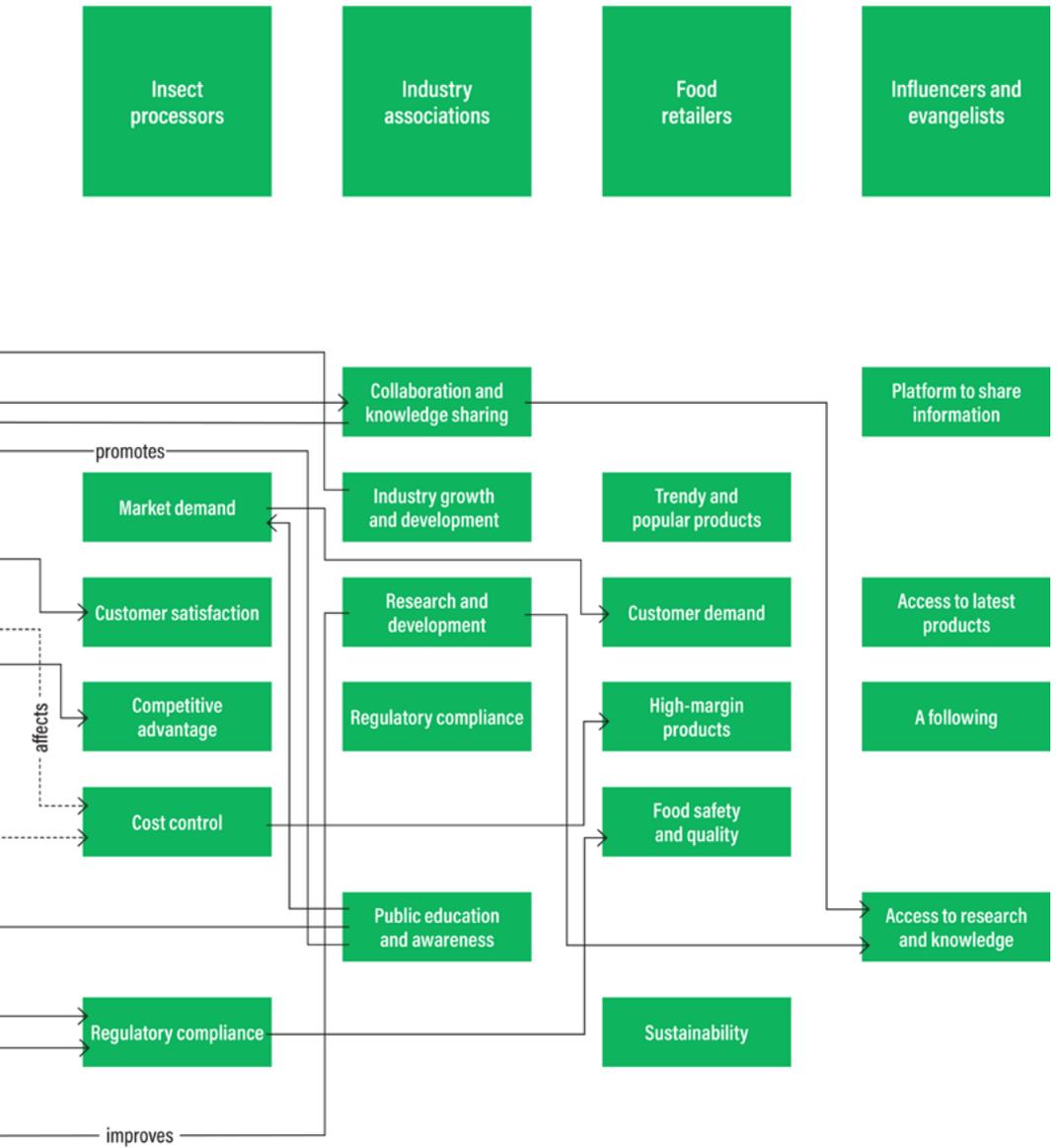


Figure 37: Influence map

Behavioural change models

We explored several behavioural change frameworks available for understanding and influencing human behaviour. These frameworks include “The Behavioural Drivers Model” which is a conceptual framework for social and behaviour change that offers a common reference and language for the study and practice of social and behaviour change (Petit, 2019) and “Smart Change” which explores the psychological mechanisms that form and maintain habits in individuals and groups and offers actionable advice to change habits (Markman, 2015). We chose to use the COM-B model owing to its comprehensiveness and wide usage. The model posits that for a behaviour to occur, an individual must have the capability, opportunity, and motivation to perform the behaviour. The model provided an integrative approach that enabled us to address multiple aspects of behaviour change simultaneously, increasing the likelihood of successful interventions. The COM-B model is versatile in application to various domains such as health, environment, and education settings. Above all, the model provided a clear and straightforward structure for understanding the key components of behaviour change.

COM-B model

The COM-B model was developed by Susan Michie, Maartje van Stralen, and Robert West in 2011 and proposes that there are “three components to any behaviour (B): Capability (C), Opportunity (O) and Motivation (M). In order to perform a particular behaviour, one must feel they are both psychologically and physically able to do so (C), have the social and physical opportunity for the be-

haviour (O), and want or need to carry out the behaviour more than other competing behaviours (M)” (Social Change UK, 2019). As evident by the single-headed and double-headed arrows in the model, each of these components interacts, and interventions must target one or more of these to deliver and maintain effective behaviour change (Michie et al., 2011).

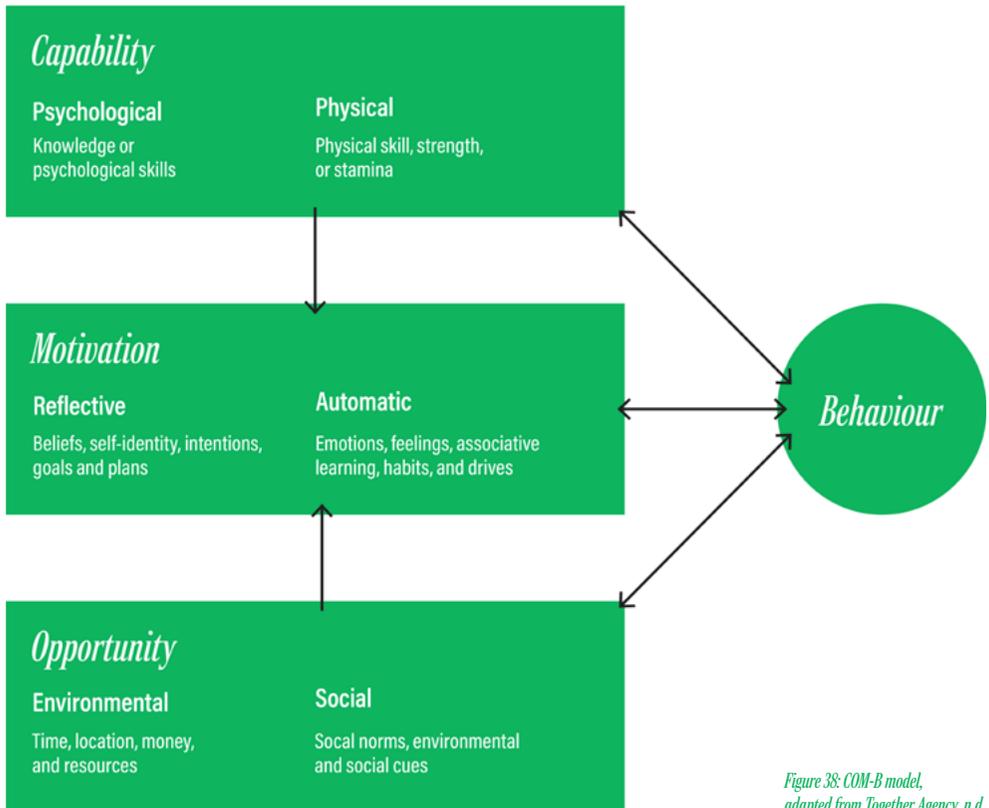


Figure 38: COM-B model, adapted from Together Agency, n.d.

Behaviour Change Wheel

The Behaviour Change Wheel is a visual representation of the overall vision of a behavioural change strategy. The wheel has the COM-B model at its core and identifies nine intervention types and seven policy categories in concentric circles. The intervention types address different aspects of behavioural change and can be used individually or in combination to successfully support the desired behaviour change. These interventions aim to target the components of the

COM-B model, ensuring that strategies are tailored to address the specific needs and challenges associated with the targeted behavior. The outermost circle of the wheel features the policy categories, which outline how interventions can be effectively implemented by governments, businesses, or organizations. These policies provide a framework for translating intervention strategies into actionable plans.

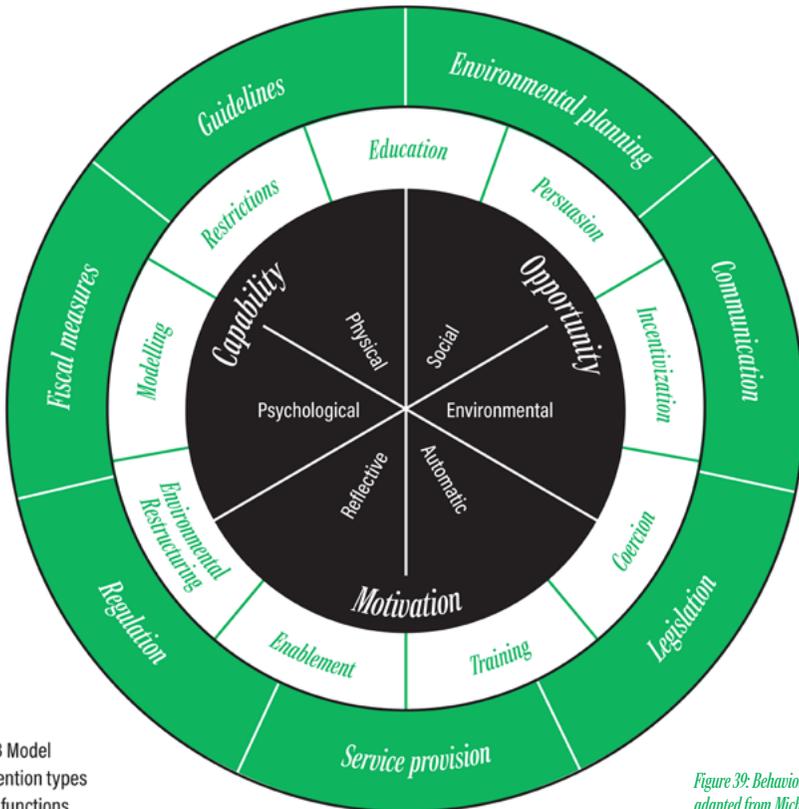


Figure 39: Behaviour Change Wheel, adapted from Michie et al., 2014

Intervention types

“Education

Informing, explaining and showing to increase knowledge and understanding.

Incentivization

Introducing payment, some other extrinsic reward, or an expectation of a desired outcome, for a behaviour.

Coercion

Introducing a cost or expected negative outcome to prevent a behaviour or to induce someone to enact a behaviour.

Modelling

Providing examples of behaviour for people to aspire to or imitate.

Restriction

Creating boundaries around what behaviours are and are not acceptable by setting rules.

Environmental restructuring

Introducing, removing or altering objects in the physical environment or shaping the social environment to prompt, facilitate or prevent behaviours.

Training

Demonstrating, supervising, providing feedback and supporting practice to improve mental or physical skills, or build habits.

Persuasion

Highlighting, arguing, discussing, proposing, requesting, pleading or helping to imagine in order to influence attractiveness.

Enablement

Providing or improving psychological, social or physical resources or treatments to support the enactment of a behaviour.

Policy functions

Guidelines: Writing instructions and advice and mounting a campaign to get these accepted and put into practice.

Environmental and social planning:

Using formal planning mechanisms to create supportive physical and social environments.

Communications and marketing: Using print media, correspondence, broadcast media and social media to present text and images, and in some cases offering an opportunity for interaction.

Legislation: Enacting and enforcing laws.

Service provision: Providing staff and resources such as mobile applications to support and enforce behaviour change.

Regulation: Creating and applying rules with sanctions for breaking them, short of legislation or by organizations that do not have the power to legislate.

Fiscal measures: Using financial rules to provide incentives or disincentives” (West & Gould, 2022).

Applying the COM-B model

What is the model used for?

The COM-B model was developed to provide a framework for incorporating insights from all the behavioural science disciplines including psychology, sociology, anthropology, economics, and neuroscience (West & Gould, 2022). Due to its interdisciplinarity, the model has become widely adopted across many sectors, including government, business and healthcare (Atkins & Michie, 2015; Barker et al., 2016; Curtis, et al., 2015; Jackson et al., 2014; McDonagh et al., 2018).

How are we using the model?

While the COM-B model is a descriptive model of behaviour, it also provides a basis for designing interventions aimed at behavioural change. To this end, we have used the model to identify the current behaviours of a specific target group, and what components of the behaviour system need to be changed to achieve behavioural change. Although the core version of the COM-B model focuses on an individual person at a given moment in time, we have generalized the behaviours to specific groups.

The process

Our process for using the COM-B model is modified and based on the processes outlined in *The Behaviour Change Wheel: A Guide to Designing Interventions* (Michie et al., 2014) and *Improving Health and Wellbeing: A Guide to Using Behavioural Science in Policy and Practice* (West & Gould, 2022):



Figure 40: Process for applying the COM-B model

The target group

Based on our survey and interview findings we have identified three distinct segments of consumers with respect to their consumption of insects. The first segment is consumers who have never consumed insects in the past due to reasons such as lack of awareness of the practice, disgust, or lack of access to insect-based products. The second segment consists of individuals who have tried insects at some point in time, indicating a willingness to consume insects but have not yet added insects to their regular diet. Finally, the third segment encompasses consumers who consume insects regularly, thereby not requiring any further intervention or strategy development.

Although businesses have been successful in encouraging consumers to take the first bite, they have been unable to create effective strategies to ensure continued consumption. By using the COM-B model, we hope to better understand the specific behaviours that inhibit regular consumption and therefore develop strategies to motivate consumers to continue eating insects.

The current behaviour of consumers

Using the COM-B model, we identified the current behaviours of individuals who have tried insects, but have yet to regularly consume insects. These current behaviours were identified through our survey and interview findings, autoethnography, and supported by previous research.

Psychological Capability

Individuals have mental barriers

Many individuals have deep-rooted mental barriers that prevent them from consuming insects. These barriers include the belief that eating insects is primitive, barbaric, and desperate, the belief that insects are pests, the belief that insects are unsafe and could lead to foodborne illnesses, and the belief that the consumption of insects is inhumane (Looy, 2014).

Not everyone seeks out adventurous experiences

Roughly 30% of the survey participants indicated that they do not perceive the consumption of insects as an adventurous activity. Although we acknowledge that insect consumption may not be suitable or appealing to everyone, it is worth exploring alternative marketing approaches that extend beyond the novelty or adventurous aspect of entomophagy.

Individuals do not understand why their current consumption habits are not sustainable

A multi-country research study with over 9000 respondents, found that 46% of people do not feel they have to change their habits for the climate (Kantar Public, 2021). Other research studies have shown that consumers often resist engaging in activities that involve some cost to themselves, despite a greater societal benefit (White & Simpson, 2013; White et al., 2019).

Individuals lack knowledge about insects

Although our survey confirmed that respondents understand the possible environmental and health benefits of consuming

insects, over 60% of participants stated that they would be more open to consuming insects if they had more information. Insufficient knowledge in this regard may include the rearing of insects, how to prepare insects for consumption, and the diverse flavour characteristics associated with different species.

Physical Capability

Individuals may be allergic to insects

Some of the same kinds of proteins that are allergenic in crustaceans are also found in some insects meaning individuals with a crustacean allergy can have allergic reactions to eating insects (Health Canada, 2021). According to the Government of Canada, in 2020, 1.9% of Canadians had self-reported a shellfish allergy, which includes crustaceans and mollusks (Health Canada, 2021).

Some individuals cannot physically buy products in stores or restaurants

As evident through our autoethnography, there is a correlation between the availability of insect-based products and geographical location. Specifically, in Toronto, Ontario, several insect-based products can be found in regular grocery stores, and some restaurants offer insect-based dishes. Conversely, access to insect-based products is notably more limited in smaller cities, such as Edmonton, Alberta.

Environmental Opportunity

Access to insect products in Canada is sparse

As the entomophagy industry is still in growth, access to insect products in restaurants and physical grocery stores remains few and far between. Despite the availability of some companies offering Canada-wide shipping through their online stores, consumers are still required to undertake additional measures. Further, at the time of writing, a few of the Canadian companies were completely sold out of their products.

Types of insect-based products available in Canada are limited

As evident through our autoethnography and analysis of Canadian entomophagy brands, the majority of available products are ready-to-eat, snack products. Such products include protein bars, whole roasted flavoured insects, and chips. Although

these products can be consumed without much effort, they are not substitutes for regular meals.

Some individuals cannot afford insect-based products

The current cost of insect proteins versus traditional and plant-based proteins is considerably higher. Recently, at the Real Canadian Superstore, one could purchase whey protein for \$3.75 for 100 grams, and plant-based protein for \$6.25 for 100 grams (Real Canadian Superstore, n.d.; n.d.). In comparison, Entomo Farms sells 100g of cricket protein powder for \$9.25 (Entomo Farms, n.d.).

Conducting research and experimenting with new foods requires time

Consumers may encounter difficulties in dedicating the necessary time to research and experiment with novel foods. This is compounded by the fact that many individuals are preoccupied with other pressing priorities, which may preclude them from engaging in such exploration.

The frequency of seeing or hearing an advertisement varies

Consumers see different frequencies of advertisements due to various factors such as where they live, how they shop, how they travel, and how they consume media.

Social Opportunity

Few Canadians have rituals around the consumption of insects

As Alhujaili et al. (2023) state, social influence can change an individual's decisions, as people usually tend to follow others because they like to conform. Over 85% of survey respondents stated that eating insects is unfamiliar. As more Canadians consume insects, there is a potential for a snowball effect to occur as consumers are influenced by their social environment and thereby influence their environment perpetuating the effect.

Socio-economic status affects the way people think about certain foods

A few studies have shown that households with higher incomes were more willing to accept insects as food in China and to consume edible insects in Poland (Liu et al., 2019; Orkusz et al., 2020).

Negative Stigma

The Western aversion to invertebrates includes the belief that these species are disgusting and are largely inedible for humans except under the most desperate of circumstances. This stigma is described as a long-existing and deep-rooted public prejudice, especially among the middle and upper classes. This bias even predates knowledge of insects as disease vectors (Looy et al., 2014).

Reflective Motivation

Some individuals don't want or need to change their eating habits

As one interview participant stated, "there are some people that are just not going to change and that's fine. Some people won't eat oranges." A recent study tracked the buying habits of nearly 38,000 US households over two years. It found that people who bought plant-based meat at least once in that period bought slightly more ground meat after their first purchase of a meat alternative—almost as if they had to make up for the experience (Reynolds, 2022).

Some people fear what others will think of them or what they would think of themselves

Although relatively low, roughly 18% of survey respondents said they are afraid people will look at them differently for consuming insects. This sentiment is echoed by research that claims that the suppression of knowledge and experience in response to perceptions of Western hegemony can lead to the refusal to eat traditional food insects (Looy et al., 2014).

Consumers have no clear understanding of what regular insect consumption could look like

As only 3% of respondents feel that eating insects is a familiar practice, it is clear that consumers lack an understanding of the practice. Evidently, 90% of the survey respondents expressed their unfamiliarity with the preparation of insects, signifying a knowledge gap. Furthermore, other unknowns could include how frequently one should eat insects and also the range of insect-based products that is available.

Automatic Motivation

Some consumers feel disgust toward novel foods

Based on our survey, 42% of participants stated that eating insects is disgusting and another 36% stated that consuming insects is weird.

People fear being forced to consume insects or replace traditional proteins with insects

With insect protein continuously being compared to traditional proteins, a growing fear in consumers' minds is that insects will replace these traditional proteins. Further, since 2018, conspiracy theories regarding the consumption of insects have started to grow. These theories claim that the World Economic Forum, along with governments, including the Government of Canada are trying to enslave people and force them to eat bugs (Butler, 2022; Jingnan, 2023).

Consumers feel no consequences for not consuming insects

Typically, recognizing the consequences of one's choices requires an understanding of the larger system in which an individual exists and operates. For many consumers, it is challenging to envision the immediate repercussions of their decisions, particularly in the context of abundant resources. In Western societies, where access to a wide variety of goods and services is commonplace, it can be difficult for individuals to comprehend the extent of their privilege and the implications of their choices.

Some people avoid unpleasant experiences

Just under 50% of respondents stated that eating insects is not enjoyable.

Some Canadians do not see insects as food

Although relatively low, 10% of survey respondents expressed the view that insects should not be consumed by humans.

The ideal behaviour of consumers

To understand better where there are gaps in the current behaviour of consumers, we have described the ideal behaviour of consumers as increased consumption of insects in Canadians' diets. Further, we have established three indicators to help us recognize if we have made progress in changing behaviours.

1. **Greater acceptance**
(level of normalization)
2. **Wider consumption**
(amount of people consuming insects)
3. **Frequency of consumption**
(how often people consume insects)

Bridging the gap

After we identified intervention targets, we began selecting possible behavioural change techniques based on the intervention types outlined in the Behaviour Change Wheel. These behavioural change techniques aim to bridge the gap between the current behaviour of the target group and our ideal behaviour.

	Intervention targets	Possible behavioural change techniques
Psychological Capability	<ul style="list-style-type: none">Individuals have mental barriersNot everyone seeks out adventurous experiencesIndividuals do not understand why current consumption habits are not sustainableIndividuals lack knowledge about insects	<ul style="list-style-type: none">Developing a Canada-specific cookbook for using insect proteinsIndustry-wide media campaign to create awareness about the history of people consuming insectsCreating opportunities to taste insects in low-stake environments (ex. placing bowls of whole roasted crickets on bar counters)Industry-wide media campaigns to drive awareness about the environmental and nutritional benefits of consuming insectsCombining insects as part of other food tasting experiences (wine, beer, chocolate) to dampen unwanted focus on insects
Physical Capability	<ul style="list-style-type: none">Individuals may be allergic to insectsSome individuals cannot physically buy products in stores or restaurants	<ul style="list-style-type: none">Increasing access to ready-to-eat, low-preparation insect productsIncreasing the visibility of insect proteins in local grocery stores and restaurants

Table 1: Intervention targets and possible behavioural change techniques

	Intervention targets	Possible behavioural change techniques
Environmental Opportunity	<p>Access to insect products in Canada is sparse</p> <p>Types of insect-based products available in Canada are limited</p> <p>Some individuals cannot afford insect-based products</p> <p>Conducting research and experimenting with new foods requires time</p> <p>The frequency of seeing or hearing an advertisement varies</p>	<p>On-the-ground awareness campaigns in schools to educate students about the benefits of consuming insects</p> <p>Increasing taxes on high-emitting protein producers</p>
Social Opportunity	<p>Few Canadians have rituals around the consumption of insects</p> <p>Socio-economic status affects the way people think about certain foods</p> <p>Negative stigma</p>	<p>Using influencers to organically show their insect consumption and how they have added it to their diets</p> <p>Initiating a "craft" segment of the insect industry that promotes high-quality products and diverse flavour profiles</p> <p>Promoting a day in a month to explore an alternative protein. (ex. insects, mycelia, algae)</p> <p>Industry-wide marketing campaign that debunks conspiracy theories</p> <p>Naturally showcasing the consumption of eating insects in movies and TV shows</p> <p>Using inclusive imagery of people consuming insects in marketing efforts (ex. families, date night)</p>

	Intervention targets	Possible behavioural change techniques
Reflective Motivation	<p>Some individuals desire or need to change their eating habits</p> <p>Some individuals don't want or need to change their eating habits</p> <p>Some people fear what others will think of them or what they would think of themselves</p> <p>Consumers have no clear understanding of what regular insect consumption could look like</p>	<p>Industry-wide marketing campaign that debunks conspiracy theories</p> <p>Using influencers to organically show their insect consumption and how they have added it to their diets</p> <p>Industry-wide media campaigns to drive awareness about the environmental and nutritional benefits of consuming insects</p>
Automatic Motivation	<p>Some consumers feel disgust toward novel foods</p> <p>People fear being forced to consume insects or replace traditional proteins with insects</p> <p>Consumers feel no consequences for not consuming insects</p> <p>Some people avoid unpleasant experiences</p> <p>Some Canadians do not see insects as food</p>	<p>Rebranding the common names of insect species on all marketing material (ex. house cricket to Acheta)</p> <p>Adding insect protein to familiar foods (ex. Kraft Dinner fortified with cricket protein, Tim Hortons chili)</p> <p>Steering away from the term entomophagy in all communications</p>

Evaluating behavioural change techniques

The APEASE criteria, outlined in *The Behaviour Change Wheel: A Guide to Designing Interventions*, is a set of evaluation criteria that can be used at any point in the process of developing, selecting, and implementing interventions (Michie et al., 2014). In our application, we have used the criteria to identify which behavioural change techniques could create the greatest opportunity for change. The APEASE criteria are as follows:

- **Acceptability:** How likely will the intervention be liked or engaged with?
- **Practicability:** How likely will the intervention be able to be delivered as planned and at the scale intended?
- **Effectiveness:** How likely will the intervention be to achieve the objective(s)?
- **Affordability:** How likely will the intervention be implemented within an available budget?
- **Side-effects:** How likely will the intervention have unintended effects?
- **Equity:** How likely will the intervention decrease inequities?

We have adapted the criteria by replacing "Effectiveness" with the three components of the ideal behaviour of consumers that we identified:

- **Greater acceptance:** How likely will the intervention lead to the normalization of the consumption of insects?
- **Wider consumption:** How likely will the intervention lead to more people eating insects?
- **Frequency of consumption:** How likely will the intervention increase the frequency that people eat insects?

In our evaluation, we have ranked each behavioural change technique on a scale from 1-4. After evaluating each technique, we developed high-level implementation strategies for the highest-ranking techniques. As the APEASE evaluation will always involve a subjective element, it is important to evaluate the behavioural change techniques again once they have been implemented. See Appendix G, for the full evaluation of the behavioural change techniques.

	<i>Behavioural change technique</i>
Acceptability: How likely will the intervention be liked or engaged with?	1-4
Practicability: How likely will the intervention be able to be delivered as planned and at the scale intended?	1-4
Affordability: How likely will the intervention be implemented within an available budget?	1-4
Side-effects: How likely will the intervention have unintended effects?	1-4
Equity: How likely will the intervention decrease inequities?	1-4
Greater acceptance: How likely will the intervention lead to the normalization of the consumption of insects?	1-4
Wider consumption: How likely will the intervention lead to more people eating insects?	1-4
Frequency of consumption: How likely will the intervention increase the frequency that people eat insects?	1-4
Total score	/40

Table 2: Behavioural change techniques evaluation

Developing a strategy for change

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Behavioural change strategies	81

Promoting the acceptance of edible insects in Canada entails addressing several key factors that are similar to those involved in the normalization of novel and new foods from diverse cultural and social backgrounds in recent decades. These factors include marketing, availability, accessibility, exposure, education on preparation, positive modelling of appealing taste and other culinary experiences. However, insects present a unique challenge as they are perceived not simply as exotic food but as inedible and repulsive (Looy et al., 2014) for some. Referring back to the survey we conducted, although respondents are aware that insects are worthy of consumption and have a fair understanding of their benefits, the majority still express an unwavering refusal to regularly consume insects.

To advocate for entomophagy, a multifaceted approach is required, addressing various levels, employing multiple means, and engaging numerous disciplines. People need to be educated about the unsustainability of our current food choices and practices, and how insects can contribute to a more equitable and sustainable food system. Also, the perception that insects are harmful must be debunked in order to differentiate food insects from species that carry diseases, are unsuitable for consumption, or cause harm. Failing to do so will maintain the significant barrier of insect disgust. Additionally, changes in structural barriers, such as food safety policies, and quality regulations, need to be advocated for (Shine, 2021).

However, efforts to improve their acceptability cannot only focus on the rational benefits of entomophagy. These have

limited appeal and researchers propose a shift from relying on a rational discourse (Berger et al., 2018; Deroy et al., 2015; Shine, 2020). Our survey distinguished this aspect and the experts we interviewed also had similar things to say. These are excerpts from some of our interviews: "If you ask someone if they want to consume crickets, they'll generally say no. But if you say, here are all the benefits cricket has, from the ability to get your fiber count up, to lose weight, have clearer skin, blah, blah, blah, then they're, they're excited about it. We also have a lot of people that identify as vegan that use our products even though our product's technically not vegan cause we got insect protein in it."; "the environmental benefit is like number 10 on the list of criteria. It's not a factor for purchase at all. Like at all."

It seems that constructs based on health and environmental benefits are insufficient to counter the strong negative reactions many people have when faced with the idea of eating insects or incorporating them into their diets. Relying solely on externally motivating "facts" neglects the cultural and emotional dimensions of attitudes and food choices (Shine, 2021).

Pull strategies

We believe interventions that utilize a pull strategy drawing consumers' attention through environmental restructuring, positive modelling and education will guide their choices and not enforce them. Pull strategies are marketing techniques that focus on attracting consumers to a product or service through natural strategies that are not forced onto the consumer. These strategies generally aim to create demand and desirability for a product through advertising, promotion, events, and other public relations efforts. By emphasizing positive experiences, sensory appeal, and unique selling points, pull strategies can create a sense of curiosity and interest in the product, leading consumers to seek it out and ultimately drive demand (European Commission, 2009).

The pull strategy can be a powerful tool and has been used successfully in various food-related contexts. For example in order to tackle invasive species through consumption, rebranding Asian carp as "Copi" (Castrodale, 2022), promoting the consumption of lionfish through the Lionfish Challenge (McNally, 2022), and encouraging the culinary use of Green Iguanas in the Cayman Islands (Marketplace, 2016) have all made uncommon food choices more attractive and enticing to consumers. The ultimate goal is not to force people to eat insects but to create a world where people want to eat insects because they taste great, are sustainable, and are healthy.

We propose that the key change agents of consumer behaviour change encompass multiple industry stakeholders, including the Government of Canada, industry associations (e.g., NACIA, Natural Product Canada), insect protein producers and processors, as well as researchers, influencers, chefs, and restaurants. In the subsequent section, we will delineate the behavioural change strategies that these change agents can employ to enhance consumer acceptance, engagement, and the eventual consumption of insect-based food products.

Behavioural change strategies

Rebranding "insects"

Rebranding the common names of insect species is an essential strategy for promoting entomophagy and facilitating the acceptance and normalization of insects as a protein source. The term "entomophagy" has historically been used by non-insect eaters to denote practices considered inappropriate in their own cultures, serving as a marker of otherness and division (Evans et al., 2015). It has been demonstrated that the naming and description of dishes, whether novel (Mielby & Frøst, 2010) or familiar (Wansink et al., 2005), significantly impact their appeal. Furthermore, associating new foods with familiar ones can enhance the willingness to try them (Tuorila et al., 1998). As Looy et al. (2014) describe it, the challenge lies in convincing an insect-averse culture to acknowledge these creatures as valid food sources.

The primary objective of rebranding is to create more positive associations and overcome potential psychological barriers related to insect consumption (Simpson, 2017). Setting environmental factors aside, the success of rebranding efforts primarily hinges on astute marketing strategies. While rebrands are often audacious, they are not a new concept. Driven by the goals of boosting sales or grabbing attention, these efforts cater to the ever-changing preferences of consumers, who require constant care (Barrie, 2021).

Notable previous examples include the Australian government's rebranding of

locusts as "sky prawns" during the country's worst locust plague in 30 years (Stout, 2016). This approach helped consumers draw parallels with familiar seafood items, thus reducing the perceived strangeness of consuming insects. At a TedX event in New Zealand, these "sky prawns," were fried, skewered with toothpicks, and artfully arranged on a bed of salad. The attendees eagerly devoured the delectable insect-based appetizer within minutes of its presentation, with over 2,000 locusts prepared and served. This example highlights the significance of a safe social setting and offers insight into the role that peer pressure can play in influencing an individual's eating habits.



Figure 4f: "Sky Prawn" locusts, from Anteater & Russel, 2016

Similarly, renaming Asian Carp "Copi" dissociates the fish from the negative connotations surrounding invasive species and being seen as 'dirty fish' since they're considered bottom feeders, and emphasizes its potential as a sustainable protein source (Castrodale, 2022). The renaming of Patagonian Toothfish to "Chilean sea bass" has also led to greater consumer demand, as the new name conveys a more appealing and exotic image (Ocean Org, n.d).

Adopting more appetizing and marketable names can significantly reduce the negative connotations and psychological barriers associated with insect consumption. This can be achieved by following naming conventions that convey a more appealing, exotic, and desirable image, emphasize palatability, and dissociate the product from its original source.

At present, Aspire FG's brand EXO employs the term "Acheta Protein" to describe the cricket powder used in their products. "Acheta" is derived from the scientific name of the house cricket, *Acheta domestica*. Dr. Aaron Dossey, the founder of All Things Bugs, introduced a rebranded name for cricket powder as "Griopro" to enhance consumer acceptance. The name "Griopro" combines "Grio," derived from "grillo," the Spanish word for cricket, and "Pro," a shorthand for protein. We advocate for a concerted, industry-wide effort to rebrand insect species as food or develop species-specific terminology that will effectively mitigate negative associations and enhance their appeal to consumers (Evans et al., 2015).

Industry associations can work to develop standardized naming conventions

and guidelines, ensuring consistency and cohesiveness across the sector. They can also collaborate with businesses and governments to promote and disseminate these new names to the public. Government bodies can support these efforts by implementing regulations or policies that encourage the adoption of rebranded insect names. And businesses can play their part by adopting the rebranded names in their marketing efforts, product development, and packaging to achieve standardization, create positive associations and reach a wider consumer base.

However, the industry at large should be aware of the risks involved in the rebranding process. There could be potential backlash from consumers who may perceive the rebranding as deceptive or manipulative. This could undermine trust in the industry and negatively affect consumer acceptance of insect-based products. Another risk is that the rebranding efforts may not resonate with the target audience or be perceived as disingenuous, thus failing to achieve the desired impact on consumer attitudes.



Flavor, texture, color Copi is a fresh local fish that is mildly flavored. The Copi flavor experience is pure, light, and clean. Its place is among the most popular white fish — more savory than Tilapia, cleaner tasting than Catfish, and less flaky than Cod.



Copi is more savory than tilapia, cleaner tasting than catfish, and firmer than cod, it's the perfect canvas for creativity – pan fried, steamed, broiled, baked, roasted or grilled.

Chef Brian Jupiter – Co-Owner & Executive Chef of Ina Mae Tavern, Chopped Champion.



Ina Mae's Copi Po Boy from Chef Brian Jupiter

Local, wild-caught fish

Copi is not only one of the most responsibly caught seafood options, it is one of the healthiest — high in heart-healthy Omega-3 and 6 fatty acids. Copi is a great source of protein.

Healthy fresh fish

Copi is a clean, top-feeding freshwater fish, eating plankton that are low on the food chain. It is also a fast-growing fish. For these reasons, it does not accumulate contaminants or heavy metals as other fish that eat higher up on the food chain, such as Tuna, Cod, and Orange Roughy.*

* Well below US Food and Drug Administration limits



Figure 42: Choose Copi website, from Choose Copi, (n.d.)

Creating safe spaces

Providing opportunities to sample insects in low-stake settings can alleviate the apprehension associated with trying something new. For instance, placing bowls of whole roasted crickets on bar counters enables patrons to casually taste insects in a relaxed social environment, without feeling singled out or pressured. Incorporating insects into established food-tasting events, such as wine, beer, or chocolate tastings, can effectively divert the unwanted focus on insects, making their consumption feel like an integral part of the experience.

Insights gathered from the expert interviews we conducted emphasize the importance of creating a safe and inviting environment when introducing people to new and unconventional food solutions. The experts suggested that one effective approach to achieving this is by replacing judgment with curiosity, which can spark interest and openness in trying new foods. Incorporating an element of fun, such as bug and wine pairings, can be highly engaging and persuasive for individuals who may otherwise be hesitant to try insects. The presence of alcohol can certainly play a role in lowering inhibitions, but the primary factor is the positive framing of the experience. By drawing parallels with other highly valued food items and presenting them in a similar context, people become more receptive to the idea of consuming insects, as evidenced and experienced by the experts we interviewed.

Another effective method to encourage people to try insects is through the power of peer influence. One of the experts we interviewed shared a personal experience of carrying crickets, ants, and other insects with her to various social settings, such as bars or gatherings with new friends. By introducing these insects as a unique and fun experience, she was able to gauge people's reactions to trying them. Peer pressure often plays a significant role in overcoming the initial hesitation to try unconventional food items. When people observe others in their social circle tasting the insects and reacting positively, they are more likely to be open to giving it a try themselves. Such experiential approaches, combined with the power of social influence, can significantly contribute to changing people's perceptions and promoting the acceptance of insects as a food source.

Further insights from the expert interviews revealed the importance of creating a comfortable environment and fostering

open-mindedness to help people overcome their initial reservations about trying insects. Another interviewee shared their experiences from events where attendees were often unaware of what they were about to encounter. In such situations, they observed that people's reactions varied, with some even experiencing genuine fear or phobias. However, by carefully setting up the environment and using familiar analogies, such as comparing insects to seafood, they were able to create a "safe space" that made people feel more at ease with the idea of trying insects. They emphasized that the key lies in sincerity and fostering an open-minded atmosphere, rather than delivering a sales pitch.

Encouraging unwilling consumers by creating a positive experience can increase their inclination to try these products, can increase future consumption, and can even mitigate the feeling of disgust, which is one of the major barriers to entomophagy (Alhujaili et al., 2023). Familiarity can be created by exposing people to insects as food in a way that can build memories, though whether or not this will lead to acceptance of the food will depend on the nature of the remembered experience, which may be good or bad (Tan et al., 2015). Given personalized attention and the right environment, people can be encouraged to overcome their initial reluctance and embrace the idea of incorporating insects into their diet.



Figure 43: Future Food Salon, from Thoufееqu, 2015



Figure 44: Insect hors d'oeuvres, from Thoufееqu, 2015



Figure 45: Preparing insect canapés, from Thoufееqu, 2015

Cultivating aspiration

Initiating a “craft” segment within the insect industry can contribute to the positioning of insect-based products as high-quality, artisanal offerings. By promoting diverse flavour profiles and creative culinary applications, a craft segment can elevate the perception of insect-based foods, thereby attracting consumers who value unique and innovative food experiences.

In our interview with an industry expert, they emphasized that the key to sparking interest in insects as a food source is to focus on the taste experience rather than solely promoting the environmental or health benefits. The expert noted that when they introduced people to ants as a culinary option, the surprising and delightful flavours generated a positive response and increased their curiosity. This suggests that showcasing insects in their whole unique form, rather than hiding them within other foods, can be an effective approach to highlight their full potential and appeal to consumers seeking unique and delicious dining experiences. During the same interview, the industry expert mentioned their collaboration with a company that had developed a processing method for mealworms, resulting in a powder that tastes and smells like chocolate. This could be used in various dishes, pancakes being one, showcasing the incredible potential for experimentation with insect-based ingredients. The expert highlighted the exciting possibilities in the realm of insect foods and the untapped potential waiting to be discovered through further research and culinary exploration.

Sensory attributes play a pivotal role in

influencing consumer acceptance of new products (Dagevos, 2021). Taste, texture, appearance, and colour are critical factors that shape product development and consequently influence consumers’ decisions regarding unfamiliar foods (Rozin, 1980). Taste is a significant predictor, irrespective of whether it pertains to conventional meat or insect-based products. The high importance placed on the taste of meat may decrease the willingness to adopt insects as an alternative protein source (Verbeke, 2015). Consumers’ acceptance of edible insects as an alternative to meat can be determined by their taste expectations and experiences. Individuals’ expectations about the taste of insects can significantly affect their reactions, as positive or negative expectations can correspondingly increase or decrease the likelihood of consuming insects (Cicatiello et al., 2016).

Let’s consider a corollary in the popularity of bitter beers, such as India Pale Ales (IPAs), which demonstrates that even tastes initially perceived as unpleasant can be appreciated and enjoyed with the right marketing and product development strategies. Craft beer consumers are characterized as novelty seekers (Malone & Lusk, 2018) with a desire for unique and non-mainstream products (Rivaroli et al., 2019). These consumers often engage in beer culture by joining beer-related organizations and actively pursuing activities to increase their knowledge of the category (Thurnell-Read, 2016).

The appreciation of bitterness in an IPA is largely determined by an individual’s perception, which can evolve over time (Sparhawk, 2013). Human taste prefer-

ences are innate from birth, predisposing children to favour sweet tastes, while sour or bitter flavours may not be immediately appealing. Disgust has its roots in the sensation of distaste, an innate rejection response to bitter-tasting substances (Fallon & Rozin, 1983; Steiner, 1979). However, disgust is elaborated through enculturation to motivate the rejection of several categories of objects or events, including food (Haidt et al., 1994). What we find disgusting is primarily learned and often culture-specific. For instance, Westerners happily consume organisms strongly associated with decay, such as fungi and marine scavengers, but often conflate herbivorous insects with those involved in death, decay, parasites, or pain, treating them all as objects of revulsion and fear. Although, as individuals grow and experience new flavours, they can learn to appreciate that not all sour and bitter tastes are undesirable. This is exemplified by the acquired taste for IPAs, which could be considered a craft beer badge of honour.

Drawing parallels with the craft beer movement, it is crucial to emphasize the unique flavour profiles of insect-based products and promote their gastronomic potential. This approach can help shift consumer perceptions and encourage the adoption of insects as a viable food source.

We believe this kind of environmental restructuring should be a collective effort of insect producers and processors, chefs and restaurants and industry associations. An effort of this kind could promote collaboration amongst industry stakeholders and create a supportive ecosystem for the development and growth of

the “craft” segment, fostering innovation and increasing consumer acceptance. However, there are certain risks associated with pushing for a “craft” segment within the industry, such as appealing only to a limited audience, a higher price point, and a lack of accessibility, almost reinforcing the perception that insects are a novel food. But again, looking at the beer industry, both the commercial and craft segments have created their own spaces to succeed.

Media shapes behaviour

The role of the media in shaping public opinion and consumer behaviour cannot be understated.

Imagery

Using inclusive imagery of people consuming insects in marketing efforts is an important consideration for fostering acceptance and promoting entomophagy as a sustainable and nutritious food source. Laura Shine, in her Ph.D. thesis titled “From Foe to Food: Entomophagy and the adoption of edible insects” highlights the current portrayals in popular media often depicting traditional entomophagy in a manner that reinforces feelings of otherness and revulsion. She discusses that such portrayals typically feature individuals of specific ethnicities consuming raw, unprocessed insects, which creates a sense of dissociation among those unaccustomed to this practice.

A more effective approach to promoting entomophagy should involve showcasing diverse and relatable individuals consuming insects in various culinary contexts. This would help counteract the negative stereotypes associated with insect consumption and emphasize the global appeal of insect-based foods.

She also highlights that the potential for earned media in this area is significant, given the intriguing nature of entomophagy and its relevance to current environmental concerns. It is essential to ensure that exposure is directed appropriately by using suitable imagery and language. Inappropriate portrayals of insect consumption can reinforce negative perceptions and further stigmatize entomophagy.

Moreover, social stigmatization surrounding insects as a food source can discourage individuals from incorporating them into their diets. Many people express concerns about being met with scorn, disgust, or mockery when sharing their interest in entomophagy with friends and family. By portraying insect consumption as a normal, inclusive, and enjoyable practice, marketing efforts can help break down barriers and shift public perception.

Showcasing relatable and positive experiences with insect-based foods, featuring diverse groups of people, such as families and couples on date nights, consuming insects, marketing efforts can foster acceptance, facilitate mutual understanding, and ultimately encourage wider adoption of entomophagy.

Influencers

Utilizing influencers to organically showcase their consumption of insects and incorporation into their diets presents a compelling approach to promoting entomophagy. Influential figures or relatable individuals who openly consume insects can normalize the behaviour, making it easier for others to envision themselves trying insect-based foods and encouraging wider acceptance. Influencers possess the capacity to raise awareness, spark curiosity, and inspire their audiences by sharing their personal experiences and lending credibility to the concept of insect consumption.

An expert interviewed for this study emphasized the importance of positive modelling in promoting the consumption of insect-based foods. They discussed the concept of mimetic desire, a phenomenon wherein individuals tend to imitate the behaviours and preferences of those



Figure 46: Questlove eats insect-topped dish, from *Quest Loves Food*, 2015



Figure 47: Angelina Jolie eats a tarantula, from *BBC News*, 2017

they admire. The expert suggested that the casual and genuine incorporation of insects into the diets of influential public figures and celebrities could contribute significantly to the normalization of insect-based foods.

A specific example provided by the interviewee was from the popular show, the *Great British Bake Off*, where a judge casually praised the use of crickets in a dish, referring to them as the future of food. This subtle endorsement from a respected culinary figure exemplifies the potential influence that public figures can exert on people's perceptions and acceptance of insect consumption.

TV shows and movies

Furthermore, the interviewee emphasized the role of popular media in normalizing and educating audiences about alternative food sources. They mention a science fiction show where it is common for characters to consume mushroom-based products in a space-travelling future. This example illustrates

how incorporating insect-based foods into popular culture and entertainment can effectively introduce the concept of insects as a sustainable and nutritious food source to wider audiences. By featuring characters who consume insects in everyday settings, these portrayals can help reduce the stigma associated with insect consumption and familiarize viewers with the idea.

There are risks involved in using these approaches, particularly through inaccurate or insensitive portrayals of insects that could further stigmatize entomophagy. The possible over-commercialization of insect-based foods could lead to skepticism or resistance among uninterested consumers. However, as displayed above, the potential is high. One of the experts we interviewed put it out bluntly, "It's such an attention-based economy and we're so distracted. We can't be too careful or guarded. Through sustained continuous efforts, we will see a change because it is inevitable."

Targeted education

Promoting on-the-ground awareness campaigns in schools to educate students about the benefits of consuming insects is a compelling approach to foster greater acceptance of entomophagy. One of the experts we interviewed highlighted the importance of integrating insect consumption education into middle school, high school, and college curricula. By reconnecting students to the origins of their food and emphasizing its crucial role in mental and physical health, a deeper understanding and appreciation for alternative food sources can be cultivated. Children, often more open-minded and fearless in trying new things like consuming insects, can champion this cause as they grow, influencing wider acceptance in the future.

Another researcher described an innovative educational tool designed for secondary school classrooms, enabling students to observe various life stages of insects in real time. Engaging students in hands-on activities related to this equipment fosters a deeper connection to insects and entomophagy. In Quebec, approximately 30 companies actively participate in school outreach programs, conducting one-hour presentations to familiarize students with insect consumption and allowing them to handle insects firsthand.

Research papers by Mancini et al. (2019) and Onwezen et al. (2021) indicate that younger and more educated individuals are more likely to accept insects as food. Creating positive experiences for reluctant consumers can enhance their willingness to try insect-based products and potentially mitigate feelings of disgust, a primary barrier to entomophagy. Targeting children with marketing strategies is particularly effective due to their more malleable food preferences. Introducing insect consumption through school programs can shift future generations' attitudes.

However, our research highlights a gap in this area; while numerous studies focus on higher education students, there is a noticeable lack of research investigating children's acceptance of insect consumption (Collins et al., 2019; Chow et al., 2021; Erhard et al., 2023).

We do anticipate skepticism, or opposition, from parents or teachers who may hold negative perceptions towards entomophagy. Parents indeed play a significant role in shaping their children's behaviors and attitudes, as they are often the primary



Figure 48: Kids explore an insect "petting zoo," from Banigan, 2017

source of reinforcement and guidance. One notable example in Canada is the controversy surrounding the sex education curriculum in Ontario. In 2015, the provincial government introduced a new sex education curriculum, which was met with protests and opposition from some parents who disagreed with the content and the age at which certain topics were introduced. This led to the government revising the curriculum in 2018 to address parents' concerns (BBC, 2018).

There could be valid concerns about allergies, food safety, or the general appropriateness of introducing insect-based foods to young children. In contrast, post-secondary education offers a unique opportunity for fostering change in young adults' attitudes and behaviors. As students enter college and university, they are often more open to exploring new ideas and adopting different lifestyle choices. This openness can lead to significant shifts in eating habits, both

positive and negative. For instance, veganism has gained traction among young Canadians in recent years. This trend can be attributed to factors such as increased awareness of the environmental and health benefits of plant-based diets, as well as the influence of social media and celebrity endorsements (Dalhousie University, 2018).

Targeting post-secondary students can be an effective strategy to encourage the adoption of insect-based foods. College and university campuses provide an ideal setting for promoting alternative protein sources, as they typically have diverse and engaged student populations. Moreover, higher education institutions in Canada have been known to incorporate sustainable practices into their operations, including food services, which could support the introduction of insect-based products (McKenzie & Vaughter, 2015).

Conclusion

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Entomophagy has emerged as a promising, environmentally friendly, and nutrient-dense alternative to traditional protein sources. This study sought to explore the barriers to entomophagy adoption in Western countries, specifically in Canada, and devised strategies to encourage behavioral change for its widespread acceptance and inclusion in diets.

The research highlighted the historical significance of entomophagy in Indigenous cultures and its decline in Western societies due to the agricultural revolution, large-scale livestock production, and psychological/sociocultural factors. Insects offer numerous health and environmental benefits, and the global entomophagy market is projected to grow substantially in the coming years. Despite growing awareness and interest in insect-based products, the adoption of entomophagy in Canada remains limited, partly due to cultural norms, personal attitudes, and fear of judgment.

The study emphasizes the need for a multifaceted approach to promote entomophagy, involving collaboration among key stakeholders, including the government, consumers, insect producers and processors, industry associations, food retailers, and food influencers. By working together, these stakeholders can help address cultural, psychological, and practical barriers, leveraging their expertise and resources to drive increased acceptance and adoption of insect-based foods.

The behavioral change strategies developed through the research include rebranding insects, creating safe spaces, cultivating aspiration, utilizing media influence, and implementing transfor-

mative education. Rebranding insects with appetizing and marketable names can reduce negative connotations and psychological barriers. Providing opportunities to sample insects in comfortable settings and leveraging social influence can help overcome initial reservations. Initiating a “craft” segment within the insect industry can attract consumers who value unique and innovative food experiences, in-turn emphasizing the unique flavor profiles and gastronomic potential of insect-based products.

Utilizing media influence through inclusive imagery and influencers can normalize insect consumption and raise awareness, while promoting awareness campaigns in schools can foster greater acceptance of entomophagy among younger generations. However, the implementation of these strategies is not without risks, and continuous efforts are required to promote positive change in public perception.

Ultimately, the research contributes to the understanding of the barriers to entomophagy adoption in Western countries and provides a foundation for future research and initiatives aimed at promoting insects as a viable supplementary protein source. By encouraging sustainable food behaviors, entomophagy has the potential to address global food system challenges, such as hunger, food waste, and food insecurity, contributing to a more sustainable future for all.

Limitations

This research study, although thorough and comprehensive, is not without limitations. In this section, we outline the key constraints and challenges faced during the research process and acknowledge areas where future research could enhance our understanding of the topic.

Bias and expertise

As researchers, we recognize that our own worldviews and knowledge may have influenced the study, which could lead to potential biases. Moreover, we acknowledge that we are not experts in the field of entomophagy, and our interpretations of the data may be limited by our level of expertise.

Participants

The participant pool for both the survey and interviews had some limitations:

Geographical representation: Due to our research team being based in Ontario and Alberta, most survey respondents were from these two provinces. Consequently, the perspectives of individuals living in the Territories, Maritimes, and rural areas may not be adequately represented in our findings.

Incentives: The absence of financial incentives for participating in our study might have affected the willingness of potential participants to engage with the research, leading to a smaller sample size and or lacking the optimum quality of responses.

US stakeholders: Due to the limited number of interview participants from Canada, we expanded our recruitment to include US stakeholders. While this increased our sample size, the perspectives of US stakeholders may not be directly applicable to the Canadian context.

Time constraints

Our research project was subject to time constraints, which led to a primarily theoretical focus. Future research could build on our findings by implementing the proposed intervention strategies and evaluating their effectiveness in real-world settings.

Indigenous perspectives

The lack of representation from First Nations, Métis, or Inuit peoples in our research is a significant limitation. As insect consumption has been historically prevalent among many Indigenous communities across Canada, not including their perspectives may result in missed opportunities to develop culturally appropriate strategies and interventions. Access to Indigenous communities and the inclusion of their insights should be prioritized in future research.

Future research

In light of the limitations discussed above, future research should focus on the following areas:

Intervention strategies

Testing the proposed intervention strategies through wind-tunneling techniques or real-world execution would provide valuable insights into their effectiveness and potential improvements.

Re-prioritization of strategies

Researchers with a fresh understanding of the industry should revisit the proposed intervention strategies and re-prioritize them based on their expertise.

Inclusion of underrepresented groups

Future studies should strive for more diverse and inclusive participant samples, ensuring the perspectives of those living in the Territories, Maritimes, rural areas, and Indigenous communities are adequately represented.

Collaboration with experts

Engaging with entomophagy experts to review and refine the research findings could help to minimize potential biases and enhance the validity of the study.

Lessons learned

In the beginning, our research project was primarily focused on gaining a deeper understanding of Canadian consumers' habits and attitudes towards insect consumption through interviews and surveys. We aimed to draw conclusions from the data gathered using our research methods, without necessarily embarking on a behavioural change journey. However, as our study progressed, we recognized the need to delve further into the complexities of consumer behaviour and the factors that influence their acceptance or rejection of insect-based products.

As a result, our research evolved into devising behavioural interventions to spur change in consumer behaviour. We explored various behavioural change frameworks and their functions, which allowed us to develop targeted strategies for addressing the challenges related to the consumption of insects and their inclusion in diets. One key insight we gained was the strong link between consumer rejection of insects and the emotion of disgust, which significantly impacts the adoption of entomophagy. This realization helped shape our approach to intervention strategy development, focusing on overcoming barriers and promoting positive associations with insect-based products. Through this process, we have not only deepened our understanding of Canadian consumption habits but also laid the groundwork for strategies that could promote widespread acceptance of insects as a viable and sustainable food source.

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Appendix

Appendix A: Interview guide

Interview should last ~45 minutes.

Introduction

We are Master of Design students at OCAD University in the Strategic Foresight and Innovation program. We have completed the coursework of our program and are now starting our year-long major research project.

We began our research with the broad topic of the future of food in Canada and more specifically alternative protein sources. We then narrowed it down to insects as an alternative protein source for humans. We see a lot of promise in insects, but we feel that there are some gaps when it comes to widespread consumer adoption.

Our research will be focused on systems-level changes, foresight, and business strategy. At this stage, we're basing our work around these research questions:

How might we educate Canadians about the unsustainability of traditional sources of protein?

How might we promote the acceptance of insects as a viable alternative source of protein to a wider audience in the Canadian market?

How can we best promote the regular consumption of insects to more Canadians?

We felt it would be valuable to speak with a few individuals directly working in the space to better understand the company, their goals, their strategies for widespread insect consumption, and their collaboration efforts.

Please note that there are no right or wrong answers, we're here to have an open discussion and learn as much as we can.

Consent

Thank you for completing the consent form. Before we begin, we would like to reiterate that you can choose to not answer a

question and may stop the interview at any time without penalty. You may also choose to withdraw your data by November 30, 2022. Do you have any questions?

Background Questions

Our understanding of [X company] is [insert understanding]. Can you confirm this understanding and possibly add to it to provide us with more detail about their mission?

Could you explain your role at [X company] and how you are leveraging your expertise toward realizing its mission?

How do you currently test markets and products?

How do you gather information about consumer sentiment and behaviour?

[Failure Questions]

How long was your business in operation?

What challenges did you face while you were in operation?

Industry Questions

How do you view the sentiment around entomophagy and insects as an alternative protein source in Canada?

How do you envision the future of insect consumption in Canada, do you anticipate a forced or a natural progression toward the widespread acceptance of entomophagy?

[Based on the response above, if they haven't addressed the barriers in some form, we will ask the question below]

What are the challenges the industry is facing currently within Canada?

Who do you see as the other major alternative protein industries? Do you feel you are competing with these industries? Do you think they face similar challenges?

Considering these challenges, how does the [X company] plan on navigating through these?

Consumption Questions

Now, since we've discussed the larger pieces, we'd like to understand in detail about your customers; the consumers and their consumption behaviours.

Are enough Canadians consuming insects?

Who are your current primary customers? Who is your ideal customer?

What do you see as the primary barrier to the widespread consumption of insects in Canada?

What other barriers do you see?

What is your company doing to address these barriers? (products, campaigns, etc)

What do you see as the best way to encourage Canadians to consume insects?

Collaboration Questions

Is [X company] a member of any larger entomophagy organization?

How do you see value in collaboration across the industry?

Do you see a need for collaboration with any other partners outside of the industry?

Wrap-Up Questions

Is there anything else that you would like to add?

Would you be open to speaking with us again in the future?

Who else should we speak to?

Appendix B: Interview analysis



Figure 49: Tag text volume

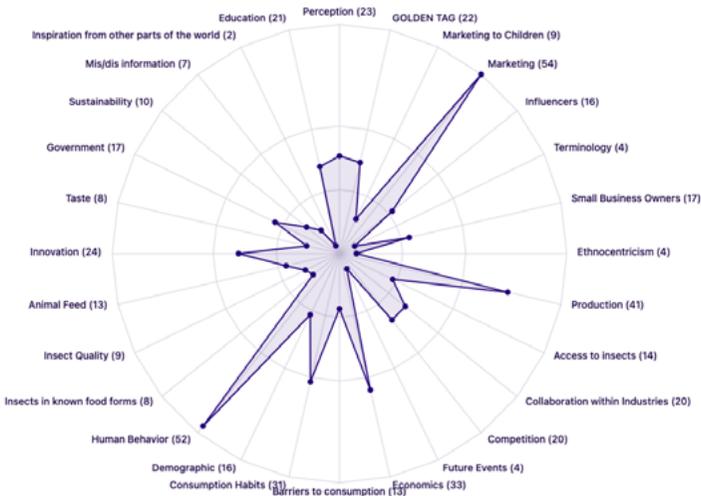


Figure 50: Radar plotting of tags



Figure 5f: Thematic analysis of interviews

Appendix C: Survey questions

Qualifying Questions

Have you read the consent form linked above?

- Yes
- No

Do you currently live in Canada?

- Yes
- No

Are you over 18 years of age?

- Yes
- No

General Consumption Behaviour

Select the option(s) that best describe your dietary preference:

- No preference
- Vegetarian
- Vegan
- Paleo
- Gluten-free
- Kosher
- Halal
- Other

When purchasing food, what is most important to you? (Rank 1-10)

- Taste
- Healthy
- Cost
- Transparency of product ingredients
- Local
- Animal welfare
- Recyclable/biodegradable packaging
- Organic
- Transparent manufacturing/
labour practices
- Good branding/package design

How do you typically choose to purchase a new food? (Select all that apply)

- Research
- Suggestions from friends or family
- Read the label in-store
- Influencers
- Advertisements
- In-store samples
- Other

Alternative Protein Consumption Behaviour

How often do you consume the following alternative proteins?

Lab-grown meat

- Never tried
- Tried once
- Once a year
- A few times a year
- Once a month
- Once a week
- Daily

Plant-based meat

- Never tried
- Tried once
- Once a year
- A few times a year
- Once a month
- Once a week
- Daily

Algae

- Never tried
- Tried once
- Once a year
- A few times a year
- Once a month
- Once a week
- Daily

Dairy alternatives (soy-based, oat-based, nut-based, etc.)

- Never tried
- Tried once
- Once a year

- A few times a year
- Once a month
- Once a week
- Daily

Plant protein (lentils, beans, peas, etc.)

- Never tried
- Tried once
- Once a year
- A few times a year
- Once a month
- Once a week
- Daily

Insect Consumption Behaviour

How often do you consume insects?

- Never tried
- Tried once
- Once a year
- A few times a year
- Once a month
- Once a week
- Daily

In what form have you consumed insects?

- Whole
- Ground/powder
- Paste
- As an ingredient in another food
- I have never consumed an insect

Rank the following statements based on how they reflect you (Untrue, Somewhat untrue, Neither true nor untrue, Somewhat true, True):

- Religious beliefs deter me from eating insects
- I would be more likely to try eating insects if I lived in a region where it is more common
- Food preferences deter me from eating insects
- If my friends or family were eating insects, I would eat them too
- Eating insects feels familiar to me
- Eating insects is no different than eating mushrooms or snails

If insects were locally available to me, I would be more likely to purchase them

Humans should not consume insects

I would be more likely to try an insect dish served at a restaurant

I do not know how to prepare insects

I am unwilling to eat whole insects

Insect dishes would be more popular if a celebrity chef cooked them

I would purchase food-grade insects to eat

Insects would be more appealing if they were hidden in other foods

Processed insect products such as cricket powder make eating insects more appealing

Insects are a good alternative to eating beef

Insects taste unpleasant

I would be more likely to purchase insects if I was able to sample them first

Eating insects promotes environmental sustainability

Insects are an all-natural food source

Insects are the solution to feeding the world

Eating insects is healthy

Insects are a good source of vitamins

Eating insects is enjoyable

I would try eating an insect for the social media post

Eating insects adds variety to my diet

Eating insects is the newest trend

Eating insects makes me feel unique

Eating insects is adventurous

Insects are a good source of protein

Eating insects is unsanitary

The names of edible insects (crickets, mealworms) are disgusting

It is not safe to eat insects

Eating insects is disgusting

I'm afraid people will look at me differently for consuming insects

Eating insects is weird

I would be more open to eating insects if I had more information

I'm unsure if my religion allows me to eat insects

Demographic Questions

What is your age?

- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65+

What is your gender?

- Female
- Male
- Non-binary/third gender
- Prefer not to answer
- Other

What is your cultural background (Select all that apply)

- African
- European
- South Asian
- Southeast Asian
- East Asian
- Indigenous
- Hispanic or Latinx
- Middle Eastern
- Prefer not to answer
- Other

What is your present religion?

- Catholicism
- Christianity
- Islam
- Judaism
- Buddhism
- Hinduism
- Traditional beliefs
- Atheism
- Agnosticism
- None
- Prefer not to answer
- Other

Including yourself, how many people live in your household?

- 1
- 2
- 3
- 4
- More than 4

How many people under the age of 18 live in your household?

- 0
- 1
- 2
- 3
- More than 3

What is the highest level of education you have completed?

- Less than high school
- High school
- Diploma or certificate
- Bachelor's degree
- Master's degree
- Doctorate

What is your household income before tax?

- Less than \$19,999
- \$20,000 - \$39,999
- \$40,000 - \$59,999
- \$60,000 - \$79,999
- \$80,000 - \$99,999
- More than \$100,000
- Prefer not to answer

What are the first three digits of your postal code? (X1X)

Appendix E: Government of Canada Funding

Pholoho Biotechnology Group Inc.

Jan 24, 2022 - Dec 31, 2022

\$115,000.00

Purpose: Buying technology

Feb 23, 2021 - Jun 30, 2021

\$108,175.00

Purpose: Working Capital

Nov 1, 2021 - May 31, 2022

\$50,000.00

Purpose: To test and parameterize and to make grow in great quantity the stock of insects in factory while reproducing its natural environment.

PROTE'INSECT LTD.

Nov 2, 2022 - Mar 31, 2023

\$65,250.00

Purpose: Establish a protein production facility

Nutrento Inc

Dec 12, 2022 - May 31, 2023

\$633,100.00

Purpose: Purchase equipment for food waste processing and the production of insect protein

Aspire Food Group Ltd.

Nov 1, 2021 - Jun 30, 2022

\$50,000.00

Apr 1, 2022 - Jan 31, 2023

\$129,351.00

Nov 1, 2021 - Aug 31, 2022

\$50,000.00

Enterra Feed Corporation

Apr 1, 2019 - Dec 31, 2019

\$6,000,000.00

Purpose: The objective of this project is to commercially produce insect-based animal feed ingredients.

Gaia Protein Ltd.

Aug 1, 2022 - Oct 31, 2023

\$160,000.00

Purpose: to support research, development, adoption and/or adaptation of innovative or technology-driven new or improved products, services or processes in Canada up to their commercialization

Centre de développement bioalimentaire du Québec inc.

Feb 2, 2021 - Jul 31, 2021

\$156,000.00

Purpose: The project aims to strengthen the technology transfer capabilities in insect processing of a research center located in the Bas-Saint-Laurent region.

TriCycle Inc.

May 30, 2022 - May 15, 2023

\$400,000.00

Purpose: to develop insect production technology and to produce foods with high nutritional value with a low environmental impact in addition to generating a by-product beneficial to vegetable crops.

Organisation for Economic Cooperation and Development

Mar 20, 2020 - Mar 31, 2020

\$97,460.00

Purpose: to explore the market potential of alternative protein sources and how the increasing demand for these products (e.g., insect, plant-based, lab cultured) is transforming the agriculture and agri-food sector globally.

Appendix F: Role of stakeholders

Entomophagy evangelists

Evangelists play an important role in the promotion of insect consumption and help drive behaviour change. Evangelists can use their platform to share information and resources about entomophagy, dispel myths, and help normalize the consumption of insects in Canada.

Food retailers

Food retailers play a critical role in promoting insect consumption through education, experimentation, and access. By incorporating insect-based dishes into their menus or offering insect-based products, they provide customers with the opportunity to taste and learn about entomophagy.

Industry associations

Industry associations are vital in promoting and supporting the growth of the industry. Associations advocate for the entomophagy industry; educate consumers, policymakers, and funders; promote collaboration between member organizations; and support further research.

Insect producers

Insect producers are responsible for developing new products, researching and implementing innovative rearing techniques, and ensuring a steady supply of insects that comply with quality standards. They also play an essential role in educating consumers about the benefits of entomophagy, creating products that cater to consumer preferences, and collaborating with restaurants and retailers to make insect-based products more widely available.

Insect processors

Insect processors are responsible for transforming raw insects into palatable and marketable products that appeal to consumers. They play a vital role in ensuring the safety, quality, and consistency of insect-based products by adhering to food safety regulations and industry standards. Insect processors also contribute to the promotion of insect consumption by developing innovative and diverse product offerings.

Consumers

Consumers have an integral role in the growth of the entomophagy industry. Consumers have the power to drive demand for insect protein as well as drive innovation through their purchasing power. As the industry continues to grow, consumers have the opportunity to share feedback and shape the development of new products that meet their preferences.

Government of Canada

The Government of Canada has a key role in supporting the entomophagy industry. Through the Canadian Food Inspection Agency, the government is responsible for regulating the safety and quality of all foods sold in Canada (Canadian Food Inspection Agency, 2019). The government also provides grants and other funding to academic institutions, not-for-profit organizations, and for-profit companies to support research and scale-up of businesses. These funding opportunities are provided by a variety of departments including the National Research Council Canada, Agriculture and Agri-Food Canada, and the Atlantic Canada Opportunities Agency (Government of Canada, n.d.). Health Canada, Canada's food guide provides guidelines and considerations on healthy eating. Lastly, the Government of Canada can support the growth of the entomophagy industry through the import and export of products.

Appendix G: Behavioural change techniques evaluation

	Acceptability	Practicability	Affordability
Increasing access to ready-to-eat, low preparation insect products	3	1	1
Increasing the visibility of insect proteins in local grocery stores and restaurants	3	2	1
Industry-wide media campaign to create awareness about the history of people consuming insects	1	2	1
Creating opportunities to taste insects in low-stake environments	1	2	3
Using influencers to organically show their insect consumption and how they have added it to their diets	3	1	2
Building rituals around consuming insects (ex. promoting a day in a month to explore an alternative protein)	1	2	2
Rebranding the common names of insect species in all marketing material	3	2	3
Developing a Canada-specific cookbook for using insect proteins	2	2	3
Industry-wide marketing campaign that debunks conspiracy theories	1	2	1

Side-effects	Equity	Greater acceptance	Wider consumption	Frequency of consumption	Total score
2	2	3	3	2	17
2	2	2	2	2	16
2	3	1	1	1	12
3	2	3	3	2	19
3	2	3	3	2	19
2	1	2	2	4	16
3	3	3	3	2	22
1	2	2	1	1	14
2	2	1	1	1	11

Table 3: Behavioural change techniques evaluation

	Acceptability	Practicability	Affordability
Initiating a "craft" segment of the insect industry that promotes high quality products and diverse flavour profiles	2	1	1
Naturally showcasing the consumption of eating insects in movies and TV shows	3	2	2
Adding insect protein to familiar foods (ex. Kraft Dinner fortified with cricket protein, Tim Hortons chili)	3	1	1
Industry-wide media campaigns to drive awareness about the environmental and nutritional benefits of consuming insects	2	2	1
On-the-ground awareness campaigns in schools to educate students about the benefits of consuming insects	2	2	2
Combining insects as part of other food tasting experiences (wine, beer, chocolate) to dampen unwanted focus on insects	2	3	3
Using inclusive imagery of people consuming insects in marketing efforts (ex. families, date night)	3	3	3
Steering away from the term entomophagy in all communications	2	2	2
Increasing taxes on high-emitting protein producers	1	1	2

Side-effects	Equity	Greater acceptance	Wider consumption	Frequency of consumption	Total score
3	2	4	3	3	19
3	3	3	3	2	21
2	2	3	3	2	17
2	3	2	1	1	14
3	2	3	3	2	19
3	1	3	2	2	19
3	2	3	2	1	20
3	3	3	1	1	17
3	1	3	2	2	15

