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Is Cricket Protein Powder the Modern Ingredient for the Protein Powder Market? A Systematic Literature Review on the Potential of Cricket Farms and Food Manufacturers in Australia and Consumers' Perceptions

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Abstract

Crickets could be a staple part of consumers' diets in the near future. Although regions of Asia have incorporated insects as part of their diets for centuries, this would be a new concept in western societies. But this concept could evolve into an innovative sector in food and agriculture in Australia. A systematic literature review is used to analyse the current edible cricket value chain. The aim is to see if Australia could create a potential market for cricket protein powder in the sports nutrition market. Overall, there is currently a small industry in Australia but overseas it is growing. It is conceivable for the insect market to reach \$10 million per year. It is a sustainable protein to produce and has an excellent nutritional profile. However, consumer perceptions regarding insect consumption in western societies is a limitation.

Key words: cricket industry, protein powder, Australia, production potential, consumer perceptions

Introduction

The Food and Agricultural Organisation reports that the population of the world will reach 9 billion people by 2050 (Ponce-Reyes & Lessard, 2021). Consequently, inventive actions need to be undertaken to meet the cumulative nutrition demand through high quality protein sources. Current food production systems and supply chains are expected to be challenged by the increasing rates of environmental damage, changing climates, mismanaged land, and pandemics. These factors signal the need to diversify the protein industry (Ponce-Reyes & Lessard, 2021).

At present, common protein sources are unsustainable (Hoffman & Falvo, 2004). For this reason, different options for human protein consumption need to be investigated such as insects. Insect farming compared to pig and cattle production emits significantly less greenhouse gases (GHG) along with ammonia (which can be converted into nitrous oxide and contributes to climate change) (Zhong, 2017). Insect-rearing facilities and farming are currently being developed due to the growing interest in insects as an alternative protein source suitable for human consumption.

Protein powder has substantial advertising investment behind it in the nutrition performance sector. While it originally targeted athletes and bodybuilders to complement their program and diet, it is expanding its demographics to those into fitness and function training as well as specific populations, such as the elderly (Churchward-Venne, Pinckaers & van Loon, 2017).

Insect farming is a developing industry that has the potential to expand rapidly in Australia. AgriFutures (2020) identified its potential to reach \$10 million per annum in the next five years. Insect farming and consumption have been common practices in Asia and Africa and gained prevalence in the last 20 years. A result has been an increase in the number of entrepreneurial businesses globally to develop innovations for insects as feed and food. However, most of these farmers are still start-ups and are not yet at a commercial scale (AgriFutures, 2020). Within western society, Europe and the United States are at the top of the domain with more than 400 insect-food based businesses (Ponce-Reyes & Lessard, 2021).

The only Australian insect industry body, the Insect Protein Association of Australia (IPAA), was formed in 2017 to support the Australian farmers and promote insect farming. This came after discussions with the International Platform of Insects for Food and Feed (IPIFF) and the North American Coalition for Insect Agriculture (NACIA) which emphasised the need for an insect industry in Australia (AgriFutures, 2020). IPAA is charged with discovering target markets, identifying research, providing advice about regulation and guidance about entering specific markets. Australia has at present three cricket farming companies that are also food producers, and four insect food manufacturers (AgriFutures, 2020).

Literature Review Process

A systematic literature review (SLR) was designed and implemented. This type of formal process was originally and solely used in the medical field. However, in recent years its application has expanded into other fields including supply chain management. Durach, Wieland & Kembro (2017) developed a six-step process for supply chain related searches: defining the research question; creating the inclusion and exclusion criteria; reviewing potentially relevant literature; selecting applicable literature; synthesising the selected literature into themes; and reporting the results.

This process was implemented. The inclusion and exclusion criteria included analytical research that could provide a greater understanding of the challenges as well as any empirical research. Relevant journals included: *Nutrition Reviews*, *Foods*, *Journal of Insects as Food and Feed* and *Journal of Supply Chain Management*. Key words and phrases were created and then adapted and combined, including 'cricket protein', 'protein powder', 'cricket farming Australia', 'markets', 'edible insects', 'non-traditional insects Australia', 'nutritional profile' and 'consumer perception'.

Not surprisingly given the infancy of this industry, only eight academic papers could be sourced. However, there were also a number of industry reviews from funding bodies and research organisations, such as AgriFutures Australia, and a number of sets of information from participants in insect value chains.

The Protein Powder Market

Protein is an important macronutrient for any diet especially among those who want to enhance their sporting performance. The target market is generally sporting individuals and those undertaking weight training. Protein can assist in weight management, maintaining lean muscle mass and increasing satiety. In society there is increased awareness of these characteristics which has

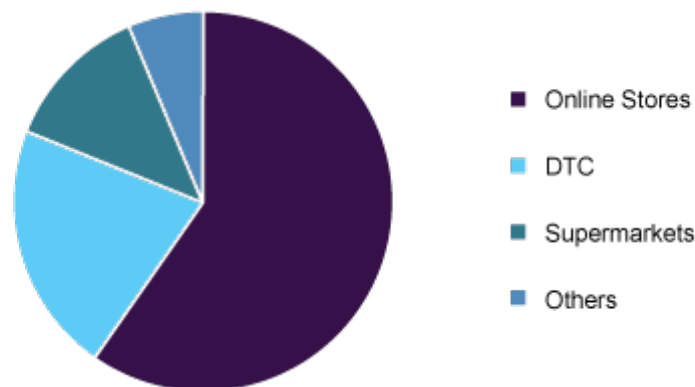
contributed to the surge in demand for protein supplements. It is evident that millennials are increasingly interested in including more protein in their daily diet (Zhong, 2017).

While the target demographic of protein powder is athletic individuals, it is also used in the aging population to maintain and/or increase skeletal muscle and to regulate appetite and support weight management (Churchward-Venne, Pinckaers & van Loon, 2017).

The global sports nutrition market accounts for several billion dollars and significant growth is expected due to the rising demand. Europe is anticipated to attain a sport nutrition market in 2025 of \$US15.12 billion (Placentino et al., 2021).

Figure 1 clearly shows that the main manner in which protein powder in 2020 was sold is through e-commerce stores, at 59 per cent. Online shopping is convenient; competitive price offers and a variety of brands are the driving factors (Grand View Research, 2021).

Figure 1. Distribution channels of the global protein powder market in 2020 (%)



Source: Grand View Research (2021). *DTC: direct to consumer

One of the popular sources of protein used in many protein powder supplements is whey. This is due to its high-quality protein source. Whey protein is not easily extracted; it requires rigorous processing to isolate the protein as it is the translucent part of milk. It is not tolerated by all, such as those with lactose intolerance which is about 65 per cent of the population. It does contain all the essential amino acids therefore being a complete high-quality protein (Hoffman & Falvo, 2004).

The demand for plant-based alternatives such as soy is ever increasing. Soybeans are part of the legume family and are a widely used vegetable protein source and are attractive for lactose intolerant individuals. However most vegetable protein is incomplete, not containing all the essential amino acids (Hoffman & Falvo, 2004).

Cricket Protein Powder

Cricket protein compared to animal protein is an equal supplement to increase protein especially in athletes. A comparison in Table 1 is made between 100g of cricket protein powder made by 'Hoppa' and a traditional whey protein isolate 'Vital Strength Lean whey high protein powder chocolate'. It shows that the cricket protein powder has similar or superior attributes.

Nutritional value

Insects are highly nutritious, containing superior quality protein along with other micronutrients. The protein content is a complete protein meaning it contains all the essential amino acids; these are

Table 1. Nutritional profile of cricket protein powder compared to whey protein powder

	Hoppa - Cricket protein powder (100g)	Vital Strength - Whey protein powder (100g)
Energy (kj)	1890	1614
Protein (g)	60.7	75
Fat (g)	23	3.4
• Omega-3 (g)	0.23	0
• Omega-6 (g)	7.36	0
Carbohydrate (g)	0.5	8.6
Fibre (g)	17.7	0
Sodium (mg)	550	230
Calcium (mg)	320	451
Iron (mg)	5.4	1.45
Potassium (mg)	560	0
Magnesium (mg)	220	51.8

Source: (Hoppa, 2021), (Woolworths, 2021). *green text indicates the superior product quality of the two.

unable to be produced by the body therefore it is crucial they are consumed. Essential amino acids are important in muscle recovery and synthesis and therefore highly desired in protein powder. An individual requires approximately 7g of essential amino acids a day to assist in daily muscle turnover (Zhong, 2017).

Additionally, they contain essential fatty-acids omega-3 and -6. They play an important role in the body for cellular functions, regulating the nervous system, blood pressure and they influence skeletal muscle metabolism. Anti-inflammatory and antioxidant effects also provide health benefits and performance recovery in regular exercisers (Gammone et al., 2019).

The minerals at high levels include copper, iron, magnesium, manganese, phosphorus, selenium, zinc, and riboflavin (Zhong, 2017).

Consumer acceptance of cricket protein

Western society is not currently acquiescent to insect consumption as it is not recognised in their diet and culture. Reasons contributing to rejecting crickets as food include food neophobia, unfamiliarity with insects, and “disgust” and “gross” factors, even though entomophagy is practiced by 2 billion people globally (Zhong, 2017).

Slowly, insect powder has been introduced into functional food products and powders of westerners due to its sustainability (Zhong, 2017).

A study amongst professional Italian athletes investigated whether they would consume insect-based food. Food neophobia towards the insect product they were given negatively contributed to

intentionally tasting and endorsing the product. Aversion was the main contributor to rejecting tasting. These athletes were then educated on the nutritional benefits along with sustainability. After the education there was an increased willingness from the participants to taste and further endorse the product. Findings also included that professional athletes provide an opportunity to promote public health especially towards the youth (Placentino et al., 2021).

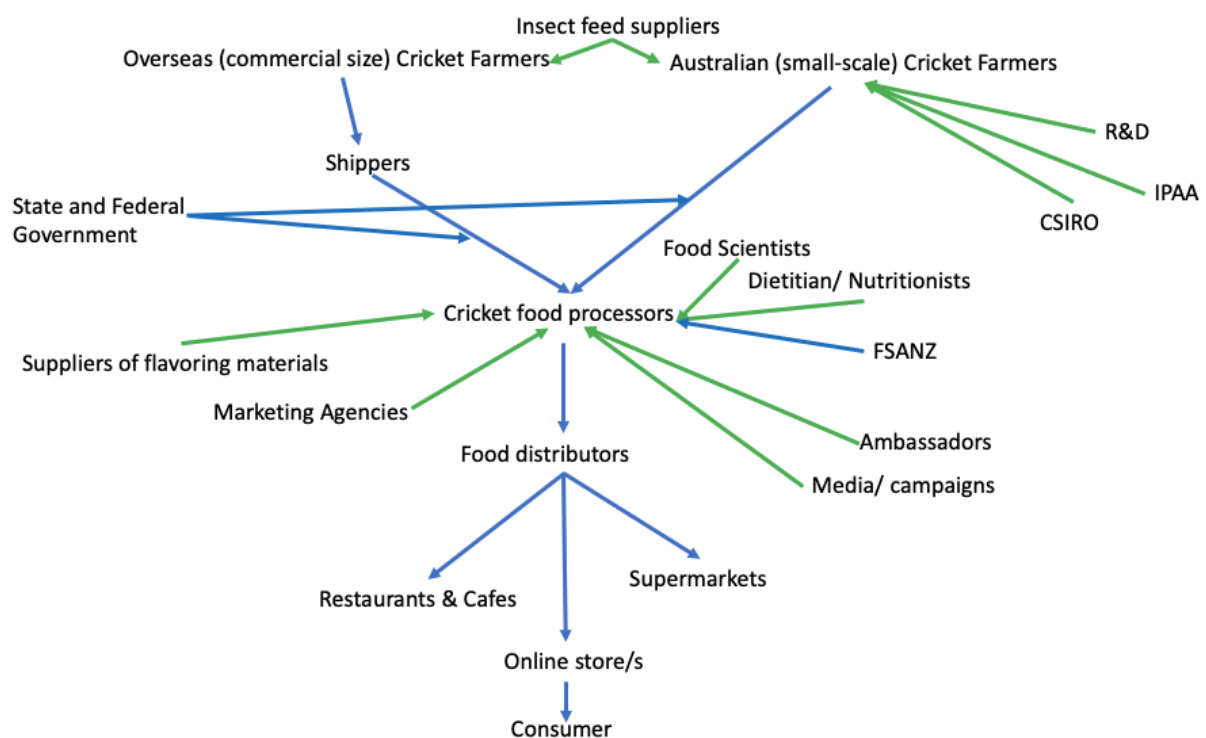
The COVID-19 pandemic has seen border closures, physical distancing, loss of work and lockdowns, all of which impact global food supply chains. This has resulted in more conscious decisions made towards the environment, healthy food, demand for fresh, healthy, locally-produced food and food accessible through e-commerce services (Ponce-Reyes & Lessard, 2021). This has resulted in a more open-minded attitude towards sustainable produce (Ponce-Reyes & Lessard, 2021).

While consumer acceptance is not high, another food that has enjoyed changed perceptions is plant-based protein, which is now mainstream. The expansion of this industry is credited to the rise in environmentally-conscious buyers (Ponce-Reyes & Lessard, 2021).

The Cricket Protein Powder Value Chain

Figure 2 maps the Australian cricket protein powder value chain. The cricket protein is sourced from either domestic or international farms.

Figure 2. Value chain map of the Australian cricket protein powder



Source: based on Salman (2018). → key actors; → functional parties

The actors of the value chain are the insect feed suppliers, cricket farmers, cricket processors, regulatory bodies, food distributors, shippers and the supermarkets, online stores, and restaurants/ cafes (Salman, 2018).

Cricket food brands are generally manufacturing their product, but they work along with other specialists such as food scientists and marketers. These positions are generally outsourced.

The opinions of final consumers need to be taken into consideration. This is where the food product formulation should reflect consumer preferences. These formulations involve food scientists in conjunction with nutritionists and/or dietitians working together to produce a product that will fulfil consumers' desires regarding taste and texture as well as provide the required nutrition (Zhong, 2017).

Farming insects in Australia

Diversifying Australia's and the global food supply chain will form more resilient food systems that can tolerate disruptions including climate change, environmental disasters, and diseases (Ponce-Reyes & Lessard, 2021). AgriFutures (2020) has stated the potential of insect farming to reach \$10 million per annum in the coming five years. However, in Australia currently, insect farmers are minor businesses or start-ups and struggle to reach a commercial scale. This has not deterred the attraction of potential investors due to Australia's favourable conditions for farming insects compared to overseas. Likewise, Australia has strong measures put in place regarding biosecurity to protect from pests and diseases (AgriFutures, 2020).

Regardless of the high potential of insect farming, it faces a number of challenges that need to be addressed. There are limited public data available both domestically and globally along with the industry not collaborating and having foundational industry knowledge to share. This is resulting in minimal information to inform regulators, providing direction to industry and importantly generating confidence for customers and investors (AgriFutures, 2020). In particular, the information provided on scalability is scarce (Ponce-Reyes & Lessard, 2021).

Sustainable farming

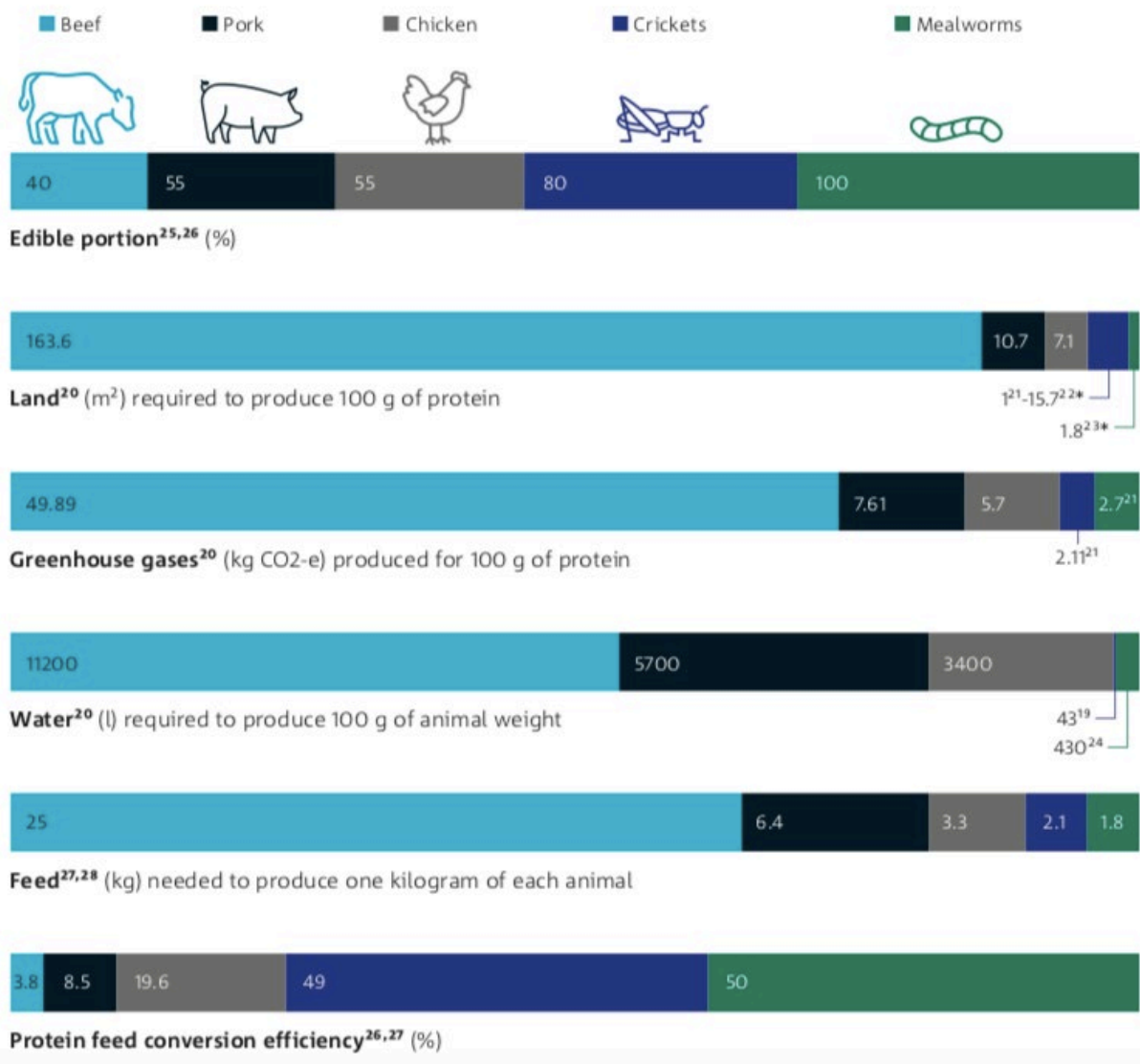
As noted above, high quality protein production for human consumption, typically, is not environmentally friendly due to the GHG emissions. This is evident as approximately 64 per cent of human-caused ammonia emissions is due to livestock farming, contributing to global climate change. As well, Zhong (2017) reports that livestock contributes 51 per cent of all GHG emissions. Plant-based proteins emit only 9 per cent as much GHG emissions therefore, in that sense, are more sustainable than livestock. However, this source of protein is not as high quality.

Insect protein is environmentally friendly, because it contains high amounts of protein in a small serving size. Likewise, insect feeding is half than of chickens and one twelfth that of cattle in a comparable serving of protein. These data reflect a high feed conversion efficiency: the insect's capability to convert their feed mass into body mass. Therefore, crickets essentially need less feed and energy to farm than other forms of livestock (Zhong, 2017). Figure 3 illustrates the sustainability of crickets compared to conventionally farmed protein.

Labour, technology and equipment required for farming

A global supply chain is emerging for developing and supplying technology and equipment manufacturers for insect farming. Australia's technology and equipment used in insect farming is idiosyncratic due to commercially accessible technology being expensive or hard to apply to Australian conditions leading to a reliance on labour saving and efficiencies (AgriFutures, 2020).

Figure 3. A variety of protein sources farming environmental footprint



Source: Ponce-Reyes & Lessard (2021)

The ever-advancing technology available is seeing smarter industries, such as robotics, operating highly efficient value chains that provide an opportunity to upscale to access food services such as e-commerce (Ponce-Reyes & Lessard, 2021). Aspire, United States-based global leaders in insect agriculture, have built autonomous robotics, distribution systems and assemblage for farming insects. Their technology can be replicated anywhere providing reliable and low-cost yield (Aspire Food Group, 2016).

Producers of cricket protein powder

While the farming is labour intensive the production process is less intensive compared to whey protein which is extracted, concentrated, and continually processed to remove other isolates. Cricket protein powder sees the whole cricket pulverised, pasteurized and dried. Crickets are bred and farmed or sourced from cricket farmers (Zhong, 2017).

As there are only a small number of insect farmers in Australia, this signifies that most of the insect producers and product developers are importing insect species from overseas. Taking advantage of established producers overseas is more cost-effective; however, it increases biosecurity risk (Ponce-

Reyes & Lessard, 2021). Product development with food scientists can form a product that is differentiated from what is already on the market.

Within Australia there are three insect food companies that produce food for human consumption: Circle Harvest (formerly Edible Bug Shop); Rebel Food Tasmania; and Grubs Up (AgriFutures, 2020). There are four insect food manufacturers in Australia including: The Cricket Bakery; Grilo Cricket Protein; Hoppa Foods; and Leap Cricket Protein. Their products and goals are shown in Appendix 1 (AgriFutures, 2020). Edible cricket products are available in major supermarket stores within Australia but predominantly are found on online stores (Ponce-Reyes & Lessard, 2021).

Regulations/ certification

Due to the product being for human consumption it requires regulations at each stage of development and production as shown in Table 2.

Table 2. Regulations regarding insect production for human consumption

Industry Practices	Regulator(s) and description
<i>Importing</i>	<ul style="list-style-type: none"> The Department of Agriculture, Water and Environment. Imported/ exported insects must be dead, and heat treated with documentation.
<i>Pest Species</i>	<ul style="list-style-type: none"> Australia's different states declare certain species as pests. Requiring written approval for the farmers from relevant state or territory authorities for the insects farmed. Biosecurity regulators are all also a part of the regulation.
<i>Food Safety</i>	<ul style="list-style-type: none"> Crickets are classified as 'non-traditional' foods and no longer a 'novel' food by the Food Standards Australia and New Zealand (FSANZ) and the Advisory Committee on Novel Foods (ACNF) which are two important regulators. The exoskeleton of crickets has similar properties to shellfish therefore it has the same allergy effects as shellfish.
<i>Food Hygiene</i>	<ul style="list-style-type: none"> FSANZ have standards 3.2.2 and 3.2.3: any business processing food for human consumption is to comply <ul style="list-style-type: none"> Regarding cleaning and hygienic practices to reduce the spread of diseases or cross-contamination.
<i>Processing</i>	<ul style="list-style-type: none"> Not officially regulated however the IPAA have general guidelines producers can follow when processing their insects. <ul style="list-style-type: none"> Including: freezing part of the slaughter process, applying heat by blanching, microwaving or cooking to remove bacteria, viruses or fungi.
<i>Country of Origin Labelling</i>	<ul style="list-style-type: none"> Australian Consumer Law Standards by the Australian Competition and Consumer Commission (ACCC) must have all warning statements and declarations made in accordance with Standard 1.2.3. <ul style="list-style-type: none"> All insect products sold must comply with the code, clear labelling about whether the food was grown, produced, made, or packaged in Australia.

Source: AgriFutures (2020)

Facilitating institutions within the cricket sector

IPAA, Entotrust and Bug Me are a few organisations in the cricket industry providing services, regulations, and support to cricket producers. The IPAA is not representative of all insect farmers as they do not all perceive value in joining. The voluntarily run association aims to gain investments to increase staffing to promote the insect industry within Australia through lobbying governments, funding annual meetings, securing grants and providing scholarships (Ponce-Reyes & Lessard, 2021). Entotrust, an independent organisation, certifies the quality, safety and environmental impact of edible insect food and beverage products. While not Australia-based, their systems could be adapted in Australia. Bug Me is a nutrition consulting service to the community to promote incorporating edible insects into the diet. For the industry to have continual growth, all sectors will have to work together and provide funding (Ponce-Reyes & Lessard, 2021).

Research into cricket protein

The increased interest in crickets as a sustainable and nutritious source of protein has triggered much interest in the form of research, especially in Australia. AgriFutures and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) have undertaken research in Australia, with assistance from the IPAA (AgriFutures, 2020). Greeninsect, based in Denmark, is a joint research organisation of universities and private partners. Their aim is to mass produce insects for nutrition and protein food sources (Ponce-Reyes & Lessard, 2021).

Pricing

The reliance on manual processing means high labour costs which then impact on the final product price. This is expensive relative to conventional whey protein being from two to four times the price. As in other agricultural sectors, which have seen production modernisation through technology reduce prices for consumers, this can be expected to occur with insect protein production.

The average wholesale price was between \$AU3.50-5.00 per kg in 2013. North-East Thailand is known to have the lowest prices for crickets due to their high production scale. They can produce 500-750 kg of harvested crickets per cycle which can generate a revenue of \$AU2,240-3,400. A Canadian insect farm in 2019 had a wholesale price of \$AU27.20 per kg, which is seen as one of the lowest prices in the west. Aspire Food, the largest cricket farm in the United States, had a wholesale price in 2019 averaging \$US54.00 per kg (Reverberi, 2019).

Marketing and media

The CSIRO stated in their research regarding the edible insect opportunity in Australia that positive and large scale media campaigns should be implemented to encourage new consumers. Campaigns should emphasise the global trends, e.g., alternative protein, the nutritional and environmental factors and education about what and how to cook with insects. The terminology used towards the consumer is important such as avoiding the term “bugs”. Media campaigns may need to work with influencers that are chefs and or celebrities (Ponce-Reyes & Lessard, 2021).

The influence that social media has towards purchasing nutritional supplements has been investigated. Social media has changed its configuration becoming a network and marketing platform opportunity for multi-million-dollar businesses. With many businesses the major goal is to influence the consumer to generate sales towards their product. A consumer segment that is observed to be highly influenced is Generation Y and Z due to their digital enthusiasm on social media. Influencers

can be opinion leaders and change the perception and opinions regarding nutritional supplements (Renga, 2017).

Australia's Current Roadmap

An insect industry roadmap for Australia has been mapped out, consisting of three recommendations which is illustrated in Table 3 (AgriFutures, 2020).

Table 3. Australian insect industry roadmap to success

Recommendation 1: Industry Convening Initiatives	Recommendation 2: Industry Guidelines	Recommendation 3: Foundational Research
Projects to promote collaborations and knowledge sharing in the industry i.e., resourcing and event support.	National guidelines with systems on processing, slaughtering, rendering, biosecurity, OHS, food safety, insect welfare and substrates.	Research into alternative uses of insects e.g., nutrition, pharmaceutical, fertiliser, waste, and pest management. Market confidence and success i.e., trials into nutritional benefits for humans. Social licensing i.e., acceptance of insects as food Regulatory decisions

Source: AgriFutures (2020)

Discussion

Cricket industry challenges

The major challenge the industry will face is the acceptance of insects consumed as food, especially as western consumers are not familiar with them. Yet there has been no testing and validation of the social licence to operate. Consuming insects by the general population would likely only complement their diet and not replace the protein. Claims about the environmental impact and insect farming sustainability compared to traditional protein are superior; however, these claims are from outside of Australia. Similarly, concerns have been voiced towards ethics in insect production (AgriFutures, 2020). Ethical constraints towards insect processing are currently absent; however, regulations could change in the future. As developing countries are the primary producers of insects, social and ethical considerations should be considered about exploiting easy access to food sources from these poorer communities. An example is quinoa, where rapidly expanding international demand for this traditional food source has meant local communities can no longer afford it (Ponce-Reyes & Lessard, 2021).

While the industry is nascent, it is highly attractive due to its growth potential and this has resulted in farmers being disinclined to share knowledge and information. This has resulted in a lack of regulations. Likewise, the farms are not large enough to conduct their own R&D.

There is a lack of transparency of regulations especially within the states of Australia. Australia only has one insect farm that has 8 to 15 employees, 35 per cent have 3 to 15 employees and the remainder have only 1 to 3. This indicates the challenge of meeting customer demand for insect-food products. The barriers farmers are facing to expand are access to technology, equipment, knowledge of efficient

commercial-scale farming and capital along with lack of customers to up-scale quantities and knowledge to breed large numbers (AgriFutures, 2020). The production costs of the product are high as labour costs are expensive and farms are lacking autonomy (Ponce-Reyes & Lessard, 2021).

Further, there are insufficient guidelines towards issues including quality control, biosecurity, occupational health and safety and additional on-farm processes (AgriFutures, 2020).

Opportunities

The insect industry is emerging in western society, with Australia having a unique and strong opportunity to be a significant contributor for the national and world food sector. With the use of cultural connections of the First Nations people and their diet, as they have long consumed insects, improving the modern diet through healthy, high-quality, and new proteins, offers major potential. Not only is it a market opportunity, but the climate in Australia is also favourable to farm insects along with Australia's highly developed agricultural research abilities in biosecurity, farming techniques and technology (Ponce-Reyes & Lessard, 2021).

As it is, the modern commercial insect industry is gaining a lot of attention and receiving plenty of funding. This is evident in the United States, where the brand All Things Bugs LLC received a \$US100,000 grant from the United States Department of Agriculture in 2013 with the intent to further develop processing techniques of insects and insect-based foods (Zhong, 2017).

Research has found that younger Australians are more willing to eat insects and this group of the population will have a major impact on future food choices. Currently the average Australian consumes more than 110kg of animal protein a year generally from poultry, beef, pork, sheep meat, and fish. Some 54 per cent of Australians are concerned about climate change. From Covid-19 to climate change, recent issues have increased awareness and interest about the link between the food consumed and produced and health and the environment, prompting the consumer to change their attitude (Ponce-Reyes & Lessard, 2021).

To support the emerging industry, wide-reaching media campaigns, with celebrity ambassadors and endorsement of social influencers, will help gain attention and interest in the market.

Conclusion

By the stakeholders in the Australian insect industry uniting and recognising the risks and weaknesses, finding opportunities, and converting them into strengths, a growing and resilient industry may emerge. At this current time the production and supply chain are not sufficiently established, but once developed it can be a resilient food system due to its ability to face environmental disturbances, such as climate change. For the increasing global population, the world needs an environmentally friendly food system and this may require diversifying our diets. Insects are effective in converting feed to body mass in contrast to conventional farmed animals in Australia. Farming crickets requires very little land especially compared to traditional animal farming.

Along with their environmental impact insects are nutritionally superior, containing the same key qualities as other animal proteins.

Through marketing crickets via protein powder, there is the possibility to launch consumer attention especially in western society. Insect consumption is generally accepted when practiced by admired individuals. Therefore, the way in which cricket protein is marketed (e.g. by athletes as they are seen as role models) could promote the use in western diets.

Likewise, the changing social climate we live in is opting for more sustainable products, so emphasising this to the consumer should be persuasive as other protein powder sources such as whey protein are not as environmentally friendly, and plant-based sources are not as nutritionally adequate.

The opportunity exists in producing cricket protein powder for developing countries to assist in enhancing their diet and incomes as exporting cricket protein is relatively low cost due to its light weight.

Ultimately, parts of the value chain need further analysis and investment to enable the cricket protein powder industry to expand in Australia. From protein powder to other food products there is potential to expand the product range.

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Appendix 1. Australian edible cricket companies, their products and average price of cricket protein powder

Company Name	About them and their products	Price (\$AU) of cricket powder per 100g
 CIRCLE HARVEST Circle Harvest	<ul style="list-style-type: none"> Based in NSW, the first Australian edible insect farm. Farms, processes and produces edible insects sold online and in commercial supermarkets. Educate the public on insects benefits by school visits, cooking demonstrations and media appearances. Products include: cricket corn chips, roasted crickets (& mealworms), cricket (& mealworm chocolate), cricket protein powder, cricket pasta, cricket dukka and granola with cricket powder. 	\$18-15.00/ 100g (Circle Harvest, 2021)
 Rebel Food Tasmania	<ul style="list-style-type: none"> Familiar food products such as peanut butter with the addition of insects such as crickets, mealworms or cockroaches to increase protein content. Innovative insect farming techniques with sustainability such as feed from seasonal vegetables and consumer waste. 	*no online store
 Grubs Up	<ul style="list-style-type: none"> In Western Australia where they farm and produce cricket products. Most insects being crickets are imported from overseas. Sell products online and supply ingredients to cafes, restaurants and street food in Perth and regional WA. Products include: roasted crickets, roasted crickets in salt and pepper, cricket dukkha and cricket powders. 	\$25.65/ 100g (Grubs Up, n.d.)
 The Cricket Bakery	<ul style="list-style-type: none"> Based in Manly (NSW) they have the aim to change perceptions of insects as food. Products include: cricket protein powder, cricket dukkha mixes and baking blends with cricket powder such as banana bread mix, seedy paleo loaf and protein pancakes (WhatCameNext_ n.d.). 	\$25.00/ 100g (Burnie, 2021)



Grilo Protein

- In Byron Bay (NSW) creating new cricket-based products for the health and lifestyle conscious consumer.
- Products sold online and in local independent grocers in Australia in Byron Bay.
- Import the cricket powder from overseas suppliers.
- Products include: roasted crickets, cricket powders, seasonings and protein bars

*no longer running

*business closed in 2021

H Ö P P A

Hoppa Foods

- A food brand producing superfoods made from crickets
- E-commerce store.
- Products include: cricket baking flour, cricket pasta and cricket protein powder. (Hoppa, 2021)

\$12.00/ 100g
(Hoppa, 2021)



Leap Cricket Protein

- Located in Melbourne, a health food store
- Products include: cricket energy bars, roasted crickets and cricket powder (Leap Cricket Protein, 2018).

\$29.00/ 100g
(Leap Cricket Protein, 2018)

Source: AgriFutures (2020)