



Eggs: protein that's good for the planet and your body

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A report for Australian Eggs Limited

by T.M. Crowley, J. Grimsey and K. Matthews

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Foreword

This project was conducted to demonstrate the benefits of egg consumption, particularly in the context of the current cultural shift within western society to reduce meat intake; with the objective of informing the public and increasing egg consumption in Australia.

This project was funded from industry revenue which is matched by funds provided by the Australian Government.

This report is an addition to Australian Eggs Limited's range of peer reviewed research publications and an output of our R&D program, which aims to support improved efficiency, sustainability, product quality, education and technology transfer in the Australian egg industry.

Most of our publications are available for viewing or downloading through our website:

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Acknowledgments

We would like to acknowledge the participants of our survey, as without their responses we would not be able to undertake the research presented in this report.

Australian Eggs Limited provided the funds which supported this project.

About the Authors

The project team has a depth of skill sets from different backgrounds and industry knowledge which has allowed us to approach the review with a realistic understanding and perspective of the Australian layer industry. All authors are research scientists affiliated with Deakin University. Ms Grimsey conceived this project but was unable to complete this project due to a job change. Her contribution and expertise in nutrition and health played a vital role in the design of this project. Dr Matthews and Prof Crowley are molecular biologists who have expertise in reviewing literature and conducting research surveys. Prof Crowley has extensive knowledge of the Australian Poultry industry.

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Abbreviations

uc	unweighted
v%	percentage
wc	weighted (population '000)

Executive Summary

The deliverables of this project are two-fold; 1. identify the positive benefits of egg consumption, 2. identify influencing factors and barriers likely to encourage or prevent consumers from perceiving eggs as an appropriate nutritional and environmentally-friendly meat alternative. By identifying the benefits of eggs and understanding what influences food choices in different consumer demographics will assist in developing effective marketing strategies useful to the Australian layer industry in challenging the meat market share. This data will be published in an open access journal publication, along with a magazine article for 'Eggstra, Eggstra', an abstract for submission to an industry meeting or conference and there is scope to submit an article for The Conversation. Two fact sheets, acting as quick reference guides, will be constructed aimed at a lay audience. Findings from this project would provide valuable content for producing a marketing video in the future. Thus, the communication and extension strategy in this project is broad, reaching industry, academia and the public, which we anticipate will help to increase Australian egg consumption. COVID19 has brought health and wellbeing to the forefront of people's minds, and thus it is a pertinent time to remind people of the benefit of eggs. Knowing what is in our food, its safety and security of the supply chain has never been more relevant. Presenting scientific data on how eggs compare nutritionally and environmentally to meat will provide a strong evidence base for recommendations to target consumer groups likely to benefit from adopting increased eggs as part of a healthy diet for all, with particular emphasis for adolescents, pregnant women and older Australians.

1 Introduction

1.1 Background

One of the most frequently asked questions in human nutrition is “are eggs healthy?”. Consumer confusion stems from the 1968 recommendation by the American Heart Association (AHA) to reduce dietary cholesterol by restricting egg intake. This recommendation reduced egg consumption in Australia by 118 eggs per capita from the 1940s to 1999, costing an estimated \$68 million profit in today’s dollar to the Australian layer industry (ABS 2008). Despite being disproven by Hu et al, 1999, the 1968 AHA claim still persists some 50 years later (Hu et al. 1999). Thus, the humble egg deserves a reputational rebuild. The demonisation of eggs is based solely on their cholesterol content, which has completely overshadowed the fact that they are an inexpensive, nutrient-dense wholefood (Herron and Fernandez 2004). Eggs contain amino acids, choline, selenium, lutein and folate which play vital roles across multiple body systems from circulation to cognition and vision (Rubin 2019). Another contributing factor responsible for reduced egg consumption is the increased prevalence of egg allergy, which has resulted in delayed introduction or avoidance of eggs in the diets of infants. However, early introduction of cooked egg can actually reduce allergy risk (Palmer et al. 2017).

While the consumption of eggs has been impacted by past myths, meat consumption within Australia is soaring. In 2012 Australia surpassed America as the global meat-eating capital consuming 92kg/person, with many exceeding the recommended 1-3 servings per week or 50g of red meat per day. This meat-centred western diet, high in processed foods and saturated fat, has resulted in 60.7% of Australians being overweight or obese (Roy_Morgan 2019). Thus, almost 10 million Australians are now consuming less meat to reduce their risk of cardiovascular disease and cancer (Roy_Morgan 2019). This cultural shift occurring in many countries provides great opportunity for eggs to partially replace traditional meat products in combination with plant proteins. Additionally, work is currently underway to produce carbon neutral eggs (Australian_Eggs 2020), which will be an important development in the competition against plant-based and lab-made meat alternatives.

Thus, if the poor (and unfounded) reputation of eggs by the public is corrected, there is vast opportunity for eggs to be further consumed as a healthy, environmentally conscious, protein source and improve the economic sustainability of the Australian layer industry. Therefore, the aim of this project was to produce a review which demonstrates the benefits of egg consumption, particularly in the context of the current cultural shift within western society; with the objective of informing the public and increasing egg consumption in Australia. This project has also generated a survey with over 1000 respondents that provides further insight into the thoughts of the Australian public when it comes to eggs as an appropriate source of protein.

1.2 Impact on the egg industry

It is difficult to accurately quantify how decades of negative publicity have impacted egg sales, but it is noted by ABS in 2000, that the average Australian egg consumption decreased markedly from 255 per capita in the late 1940s to 137 in the late 1990s, a decrease of over 46%, representing a \$70 million financial loss to producers. Australian households spend over \$12 billion per annum on meat compared to \$961 million on eggs (ASIC, 2016) (Australian_Eggs 2020). Eggs occupy a lower price point than that of meat but even penetrating the meat market at a level of 1% represents a \$120 million gain in market share. Based on an average retail cost of \$3.50 per dozen, with producers selling to stores for \$2.20, this market gain would mean an extra 34 million dozen eggs in demand at

a profit of \$20 million into Australian farmer's pockets (assuming \$0.60 profit per dozen eggs for the producer). Hence, it is easy to see the huge potential that eggs have in the Australian market which provide vast financial gains for both individual farmers and the Australian egg industry as a whole.

2 Literature Review

2.1 Introduction

The aim of this project was to produce a review which demonstrates the benefits of egg consumption as a nutritionally and environmentally-appropriate alternative to meat; thereby potentially increasing consumer demand of eggs, which could result in increased profits to the Australian layer industry in the realm of \$120 million per annum (assuming penetration of the meat market at a level of 1%). With close to half of all Australians conscious of reducing meat intake combined with the financial strain of COVID19, it is a pertinent time for shifting consumer attention to eggs as an affordable wholefood source. The economic downturn is impacting people of poor socio-economic status, and people in rural and remote communities who may already have been subjected to trauma from bushfires and drought, which includes layer producers.

The review provides up to date data and recommendations of the benefits of egg consumption. It links nutritional advice to the environmental impacts of the food sources, where practical. Although it must be noted that there is still a great deal of missing information particularly when investigating the real environmental impact of plant based protein sources. Social determinants influencing food choices have been explored, providing powerful health promotion material suited to cohorts deemed most likely to redirect meat spending towards the alternative protein markets, such as eggs. Clear and concise recommendations from a reputable source can boost consumer confidence especially in shoppers with low food literacy. Presenting easy to understand nutritional advice to Australia's most vulnerable groups is essential to prevent widening of health inequalities. Increasing egg sales will also benefit producers as previously discussed. Deriving methods for enhancing access to those most at risk is an important element underpinning this review.

2.2 Materials and Methods

Throughout the project, we were in communication with key industry members to ensure our review clearly reflects the capacity of the Australian poultry industry and aligns with their needs. Data was sourced from scholarly articles via academic search engines including Google Scholar, Pubmed and ScienceDirect. Data from market research companies such as Roy Morgan was also used for profiling consumer traits. Government websites including Australian Bureau of Statistics and OECD provided food consumption information.

2.2.1 Results

We successfully generated a review article that is currently under review at Anthrozoos. Once accepted for publication we will generate an article for The Conversation that will be released shortly after the publication of journal article. The review article has been submitted with this final report but will not be released until after its official publication in the journal.

3 Survey

3.1 Introduction

To complement the review that we generated in this project we sought to undertake a survey that would explore people's perceptions of eggs. Specifically we were interested in their thoughts on eggs as a replacement for meat based protein and their perceived environmental impact.

3.2 Materials and methods

We generated an initial list of 20 multiple choice questions of which we circulated to a panel of industry experts that provided feedback. After receiving the feedback we also consulted the industry experts vis phone/Zoom to further understand their feedback. Taking the feedback into consideration we were then able to reduce the questions to a final set of five which are listed below (section 3.2.1). To ensure a high response rate we engaged Roy Morgan to execute the survey on our behalf. This had additional benefits of being able to source additional information about respondents such as;

- Gender
- Age
- Location (state)
- Employment status
- Employment industry
- Income

We were also guaranteed a minimum of 1000 respondents for each question. Roy Morgan then provided us with the raw data for us to calculate the percentage responses for each question, taking into account the additional demographic data that was collected. Statistical analysis and percentages were calculated using macros in Excel and all graphs were generated in Excel. Both unweighted and weighted counts have been calculated. The unweighted counts are the number of respondents and the weighted counts (sums of weights) are intended to represent the population in thousands.

3.2.1 Final survey questions

And now a few questions about eggs...

EGQ1a. How many eggs do you currently eat per week?

1. 1-2
2. 3-4
3. 5-6
4. 7-8
5. 9+
99. Unsure

EGQ1. What would make you eat more eggs?

Tick all that apply

1. Bigger size

2. Tastier egg
3. Higher nutrient content per egg
4. Reduced cost per egg
5. Other (please specify)
99. Unsure

EGQ2. Do you think eggs are an adequate source of protein that could replace meat on a daily basis?

1. Yes
2. No
99. Unsure

EGQ3. If you were replacing a steak meal with eggs, how many eggs do you think you would need to eat to meet your protein needs?

1. 1-2
2. 3-4
3. 5-6
4. 7-8
5. 9+
99. Unsure

EGQ4. If you were eating only eggs as a replacement for meat, do you think you would need to add vegetables or plant-based proteins to your meal to feel full?

1. Yes
2. No
99. Unsure

EGQ5. Rank the products below which you believe have the highest environmental impact:

- 1- Highest environmental impact
- 5 - Lowest environmental impact

1. Red meat (e.g. Beef, Lamb etc)
2. White meat (e.g. chicken, rabbit etc)
3. Fish
4. Eggs
5. Plant-based proteins (e.g. grains, legumes etc)

3.3 Results

The survey captured responses from a total of 1058 people. Note that only a subset of the data is represented here, the entire dataset has been provided as a supplementary Excel file. The overall demographics of the respondents are shown in Table 3.1. There was an even spread of people in each age group and gender but not in terms of location. A high proportion of respondents were overrepresented in the health care and social assistance (101) and education and training (93) employment industries.

Table 3-1 Demographic data (unweighted) for all 1058 respondents of the survey.

		TOTAL RESPONDENTS	1058
GENDER	Male		514
	Female		544
AGE - SUMMARY	18-34		295
	35-49		259
	50-64		231
	65+		273
STATES	ACT		23
	NSW		331
	Victoria		274
	Queensland		213
	SA		80
	NT		7
	Tasmania		22
	WA		108
WORK STATUS	Employed Full-time		434
	Employed Part-time		217
	Looking For Full-time work		16
	Looking For Part-time work		21
	Home Duties		33
	Retired		252
	Student / Currently studying		10
	Not working		54
	Prefer not to say		21
EMPLOYMENT INDUSTRY	Accommodation and Food Services		17
	Administrative and Support Services		16
	Agriculture, Forestry and Fishing		12
	Arts and Recreation Services		16
	Construction		25
	Education and Training		93
	Electricity, Gas, Water and Waste Services		15
	Financial and Insurance Services		32
	Health Care and Social Assistance		101
	Information Media and Telecommunications		21
	Manufacturing		29
	Mining		12
	Professional, Scientific and Technical Services		53
	Public Administration and Safety		49
Rental, Hiring and Real Estate Services		6	

	Retail trade	49
	Transport, Postal and Warehousing	32
	Wholesale trade	8
	Other industry	54
	Don't know the industry	5
	Prefer not to say	6
INCOME - DETAILED	Less than \$6,000	30
	\$6,000 - \$9,999	12
	\$10,000 - \$14,999	21
	\$15,000 - \$19,999	38
	20,000 - \$24,999	54
	\$25,000 - \$29,999	50
	\$30,000 - \$34,999	39
	\$35,000 - \$39,999	35
	\$40,000 - \$44,999	47
	\$45,000 - \$49,999	40
	\$50,000 - \$59,999	51
	\$60,000 - \$69,999	68
	\$70,000 - \$79,999	63
	\$80,000 - \$89,999	64
	\$90,000 - \$99,999	60
	\$100,000 - \$109,999	65
	\$110,000 - \$119,999	35
	\$120,000 - \$129,999	37
	\$130,000 - \$149,999	38
	\$150,000 - \$199,999	37
	\$200,000 - \$249,999	18
	\$250,000 - \$299,999	12
	\$300,000 Or More	3
	Can't say	32
	Prefer not to answer	109

The majority of people surveyed consume between one to four eggs per week (65 %) (Figure 3.1). However, there were 9 % of people who were unsure of how many eggs they eat per week. 20 % of respondents eat between five and eight eggs per week.

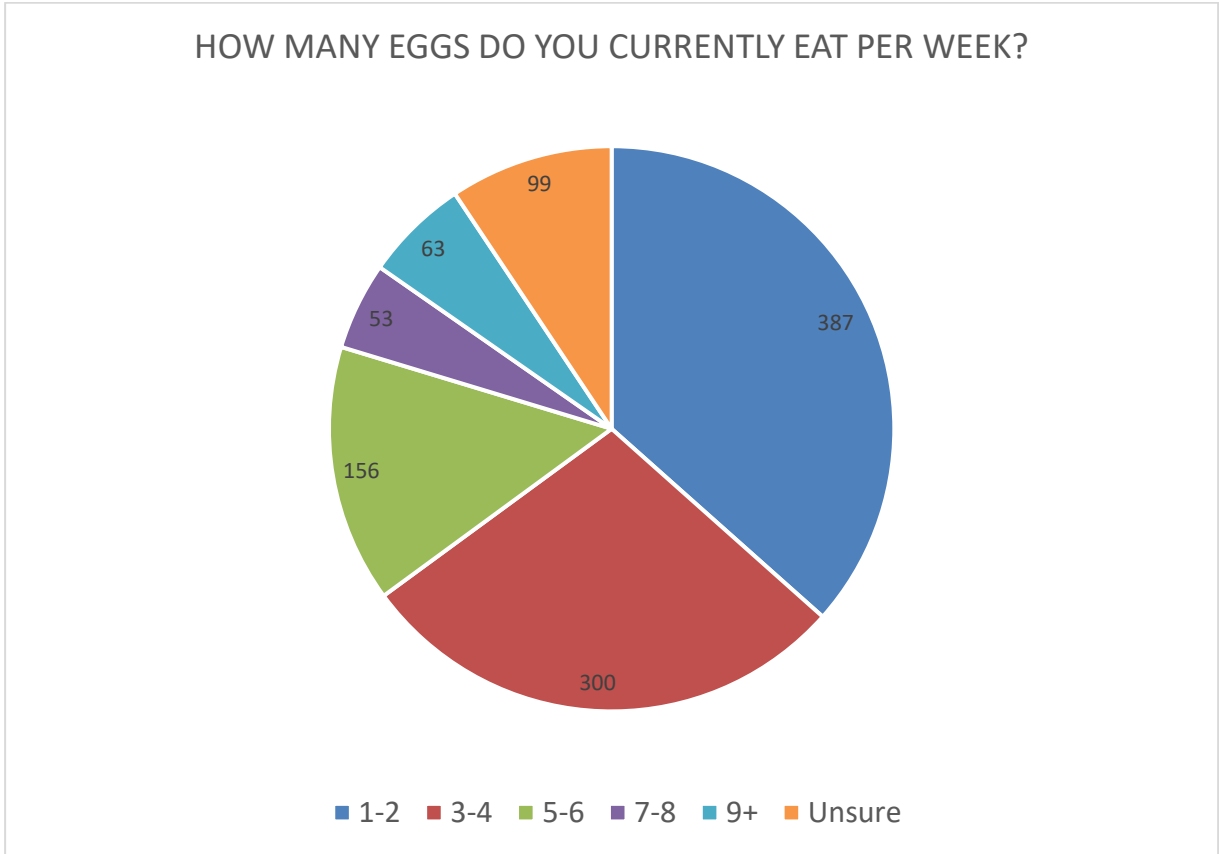


Figure 3-1. Responses to question one “How many eggs do you eat per week?”. Values inside pie chart are displayed as unweighted values. The legend represents the number of eggs consumed in response to the question.

When asked what would make you eat more eggs, a large proportion (45 %) were unsure, followed by 22 % who stated that reduced cost would increase their consumption of eggs (Table 3.2). Only 3 % of the people surveyed cited ethically produced/ free range/ better conditions for chickens as reasons for wanting to consume more eggs. 26 % of respondents highlighted that certain physical properties (bigger, tastier or higher nutrient content) would encourage them to eat more eggs.

Table 3-2 Responses to question 1a “What would make you eat more eggs?”. Values displayed here include unweighted (uw), weighted (wc) and percentage (v%).

		TOTAL
(unweighted)	uc	1058
(popn. '000)	wc	19983
WHAT WOULD MAKE YOU EAT MORE EGGS?		
Bigger sizes	uc	71
	wc	1333
	v%	6.7%
Tastier eggs	uc	105
	wc	1986
	v%	9.9%
Higher nutrient content per egg	uc	100
	wc	1915
	v%	9.6%
Reduced cost per egg	uc	234
	wc	4479
	v%	22.4%
Ethically produced/ free range/ better conditions for chickens	uc	28
	wc	533
	v%	2.7%
Availability on the shelf/ easy access locally	uc	12
	wc	233
	v%	1.2%
More/ different/ better recipes including eggs/ how to cook them	uc	11
	wc	210
	v%	1.1%
More time/ motivation to cook/ if cooked for me/ if eat at home more often	uc	19
	wc	373
	v%	1.9%
Nothing (unspec)	uc	33
	wc	613
	v%	3.1%
Eat enough eggs/ eat them when I want to/ depends what I feel like eating or cooking/ diet change/ only use them as an ingredient/ have our own chickens	uc	52
	wc	925
	v%	4.6%
Don't eat eggs/ don't like them/ we are vegan	uc	24
	wc	463
	v%	2.3%
Can't eat eggs - allergic/ intolerant/ they make me ill	uc	10
	wc	201
	v%	1.0%
Other	uc	21
	wc	386
	v%	1.9%
Unsure	uc	475
	wc	8950
	v%	44.8%

DO YOU THINK EGGS ARE AN ADEQUATE SOURCE OF PROTEIN THAT COULD REPLACE MEAT ON A DAILY BASIS?

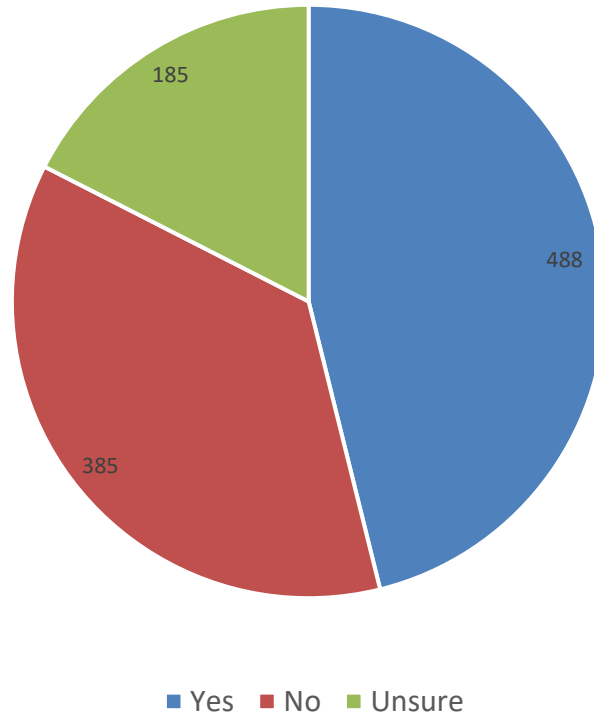


Figure 3-2 Responses to question one “Do you think eggs are an adequate source of protein that could replace meat on a daily basis?”. Values inside pie chart are displayed as unweighted values. The legend represents the number of eggs consumed in response to the question.

Nearly half (46 %) of respondents think that eggs are an adequate source of protein that could replace meat on a daily basis, while just over a third (36 %) don't agree (Figure 3.2). Almost 40 % of the people surveyed believe that three to four eggs would be sufficient to meet their protein needs when replacing a steak meal (Figure 3.3). A large proportion of people (80 %) think that they would need to add vegetables or plant based proteins to their meal in order to feel full (Figure 3.4). Only 10 % of people thought that they would not require vegetables or plant based proteins with their eggs to make them feel full.

IF YOU WERE REPLACING A STEAK MEAL WITH EGGS,
HOW MANY EGGS DO YOU THINK YOU WOULD NEED TO
EAT TO MEET YOUR PROTEIN NEEDS?

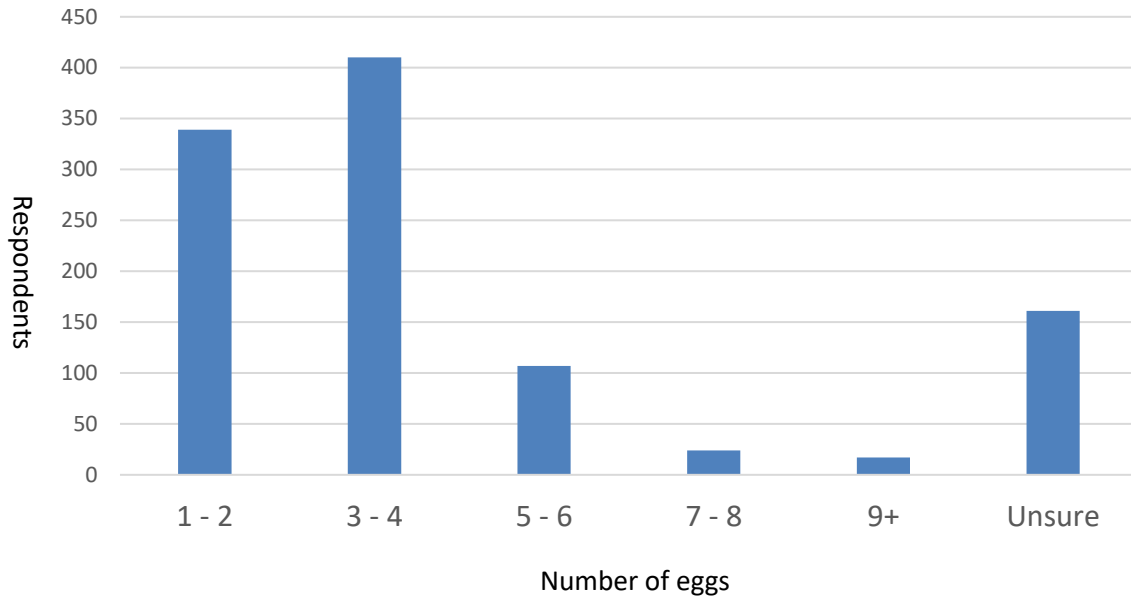


Figure 3-3 Responses to question one “If you were replacing a steak meal with eggs, how many eggs do you think you would need to eat to meet your protein needs?”. Respondent values are unweighted values.

IF YOU WERE EATING ONLY EGGS AS A REPLACEMENT FOR
MEAT, DO YOU THINK YOU WOULD NEED TO ADD VEGETABLES
OR PLANT-BASED PROTEINS TO YOUR MEAL TO FEEL FULL?

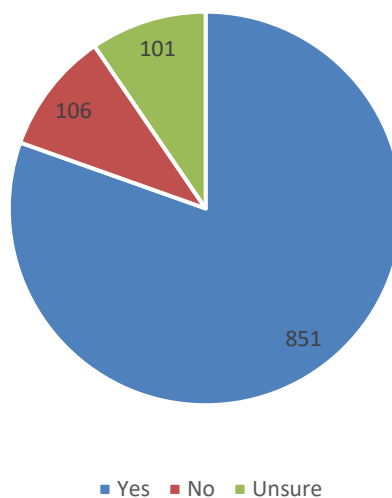


Figure 3-4 Responses to question one “If you were eating only eggs as a replacement for meat, do you think you would need to add vegetables or plant-based proteins to your meal to feel full?”. Values inside pie chart are displayed as unweighted values. The legend represents the number of eggs consumed in response to the question.

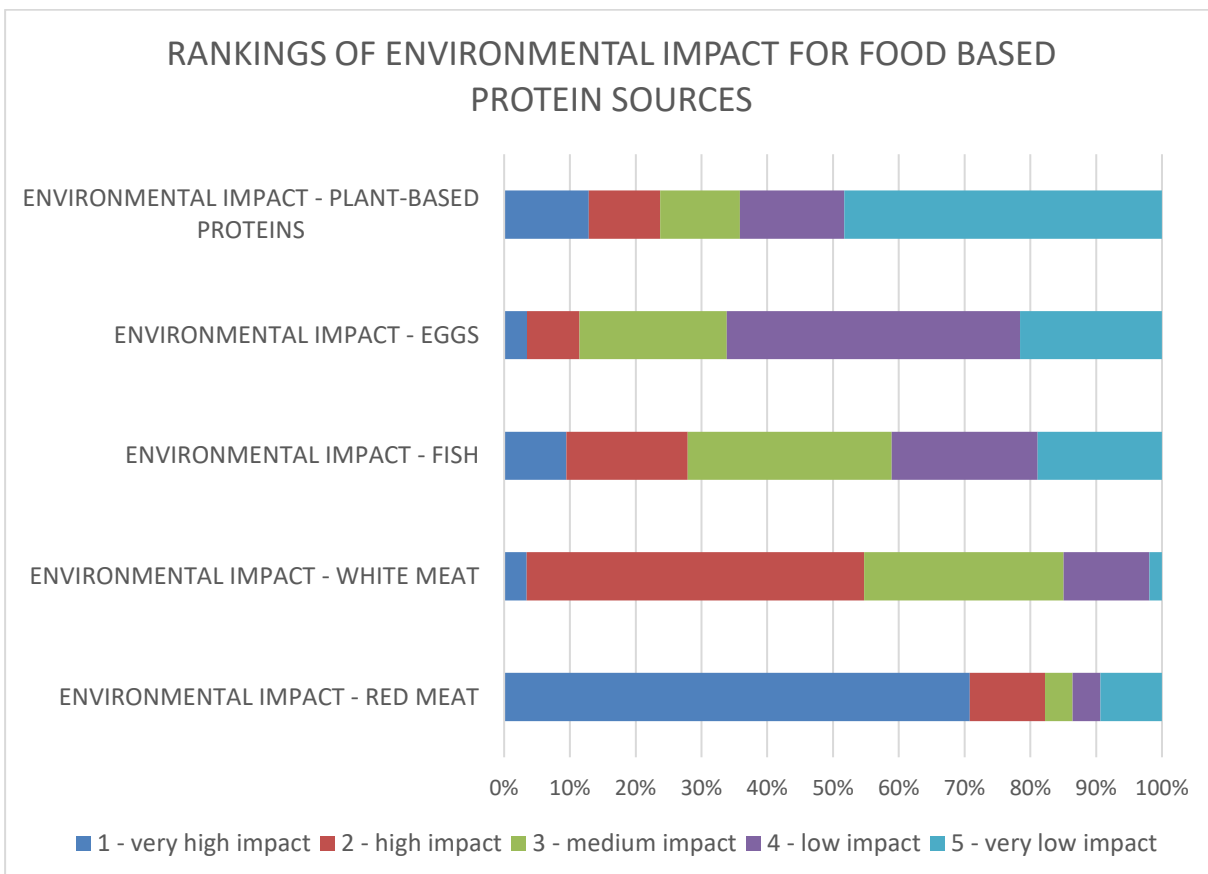


Figure 3-5 Responses to question one “If you were eating only eggs as a replacement for meat, do you think you would need to add vegetables or plant-based proteins to your meal to feel full?”. Values inside pie chart are displayed as unweighted values. The legend represents the number of eggs consumed in response to the question.

A large proportion (71 %) of people surveyed responded that red meat has a very high impact on the environment, whereas only 3 % thought eggs had a very high impact (Figure 3.5). 48 % of respondents think that plant based proteins have a very low environmental impact compared to 22 % who though eggs have a very low environmental impact.

3.4 Discussion

The survey presented here attracted over 1000 respondents and has highlighted some interesting thoughts and perceptions, some surprising and others well documented previously. We were able to get a very even spread of respondents in terms of gender and age range however, there was an overrepresentation of respondents from certain employment industries. These were education and training and health care and social assistance and given the required high level of education often required in these professions it may have had an influence on the results. On further interrogation of the data it does not appear that these groups have all responded in the same way, so although we cannot completely dismiss the overrepresentation we are unable to demonstrate there has been any statistically significant impact on the overall responses.

The number of eggs consumed on average by respondents is consistent with the reported figure of 246 eggs per year consumed by Australians (Australian_Eggs 2020). When asked about what would

make the respondents eat more eggs the top response was reduced cost of eggs. This is more in line with what we know consumers actually do when making decisions at the cold face (in the supermarket) but in contrast to what people usually say they will do when asked (Bray, Buddle, and Ankeny 2017). As previously reported consumers are more likely to take physical properties such as size, taste and added nutritional value into account when purchasing eggs (Bray and Ankeny 2017). It was promising to see that nearly half of the respondents thought that eggs were an adequate protein replacement for meat that could be consumed on a daily basis, which alludes to the potential to increase the number of eggs consumed each year in Australia to be more in line with other countries such as Mexico who eat on average 347 eggs per person per year (Giannetto 2016). Further, a large proportion of respondents thought that one to four eggs would be adequate to replace meat and meet their protein needs. It would be interesting to interrogate this finding a little further in the future to understand how respondents came up with how many eggs are equivalent to meat and to see how this compared with the true protein content per gram of both eggs and meat.

As we discovered in our review article there is a great deal of mis-information and lack of information around the environmental impact of plant based proteins. This was evident in our survey where nearly half of all respondents thought plant based proteins have a very low environmental impact despite their being a lack of scientific data to support this claim (Karlsson Potter and Rööös 2021). It would be beneficial to understand why respondents believe this to be true and provides a great opportunity for further study.

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Plain English Summary

Project Title:	XXXX
Australian Eggs Limited Project No	Eg.1US121
Researchers Involved	TM Crowley, K Matthews, J Grimsey
Organisations Involved	Deakin University Geelong Australia.
Phone	03 5227 1328
Fax	N/A
Email	Tamsyn.Crowley@deakin.edu.au
Objectives	The objectives of this project are two-fold; 1. identify the positive benefits of egg consumption, 2. identify influencing factors and barriers likely to encourage or prevent consumers from perceiving eggs as an appropriate nutritional and environmentally-friendly meat alternative.
Background	By identifying the benefits of eggs and understanding what influences food choices in different consumer demographics will assist in developing effective marketing strategies useful to the Australian layer industry in challenging the meat market share. This data will be published in an open access journal publication, along with a magazine article for 'Eggstra, Eggstra', an abstract for submission to an industry meeting or conference and there is scope to submit an article for The Conversation. Two fact sheets, acting as quick reference guides, will be constructed aimed at a lay audience. Findings from this project would provide valuable content for producing a marketing video in the future. Thus, the communication and extension strategy in this project is broad, reaching industry, academia and the public, which we anticipate will help to increase Australian egg consumption.
Research	This project contained a literature review and short survey on egg consumption and perceptions.
Outcomes	This project produced a literature review and a short survey investigating consumer attitudes to eggs and other sources of proteins.
Implications	This project has highlighted some opportunities where the generation of adequate information could increase the consumption of eggs in Australia. It has also highlighted the misconceptions and lack of information about plant based protein sources, in particular their environmental impact and nutritional content.
Key Words	Protein, eggs,
Publications	Publication currently under review