



**A Nuffield Farming Scholarships Trust  
Report**

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THE MACROBERT TRUST

**Explore new ways  
eggs can be marketed  
to maintain a steady increase  
in egg consumption**

**Jamie McIntosh**

**October 2019**

NUFFIELD UK

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# A Nuffield (UK) Farming Scholarships Trust Report



Date of report: *October 2019*

*"Leading positive change in agriculture.  
Inspiring passion and potential in people."*

Title	Explore new ways eggs can be marketed to maintain a steady increase in consumption
Scholar	Jamie McIntosh
Sponsor	The MacRobert Trust
Objectives of Study Tour	<p>Highlight why egg consumption should increase and identify the main challenges in doing so.</p> <p>Explore different strategies for promoting the health benefits from consuming eggs</p> <p>To learn from other countries new marketing strategies for increasing egg consumption</p>
Countries Visited	Canada, U.S, Colombia, Denmark, Poland, Italy, China, Japan
Messages	<ul style="list-style-type: none"><li>• There is considerable potential for egg consumption to increase</li><li>• Science-based health messages on eggs are positive and clear – now is the time to capitalise on all health benefits</li><li>• However, several threats to consumption growth need consideration</li><li>• There are many options left as to how the egg can be presented to the consumer</li></ul>

## EXECUTIVE SUMMARY

Despite growth in recent years, egg consumption in the UK is only 199 eggs per person per year. This is behind Italy at 215, Germany 230, and Colombia 280. I wanted to research new marketing techniques and the likely potential for the UK market.

During my study tour I travelled widely to countries with high egg consumption and strong market growth and spoke to many experts in the industry.

I believe the egg has a bright future. It has the right ingredients for continued market success: one of the most nutrient-inclusive, cost-effective and versatile foods out there. An egg contains the highest quality protein, an abundance of other essential nutrients and is only around 75 calories.

Why does this matter?

Not only will increased egg sales be an obvious benefit to the industry, but a critical issue of our modern society would be addressed. The UK is facing a major health crisis. Obesity rates have risen dramatically in the last 25 years as have the number of people living with diabetes. Cardiovascular disease and mental illnesses are also on the increase. Inadequate nutrition is a leading cause and evidence suggests increased egg consumption can help.

Eggs are a natural medicine, promoting health and wellbeing and should be considered instrumental in preventing and alleviating existing health conditions.

The UK egg market has a solid grounding based on the work of the British Egg Industry Council, including its respected food safety trademark the Lion, and by recent positive news stories on the health benefits of eating eggs.

How else can we better advertise the health benefits? I have discovered many examples of how different marketing techniques have been used to promote the egg through social media and street events; and different ways of targeting both the consumer and improved interaction with large food manufacturers. Many of these are detailed in this report.

I have looked at new ways of selling eggs such as in the way they are packaged; sizing, branding, catering and processing, many of which are not prevalent in the UK. Branding can be used to target specific age, health and lifestyle groups such as pregnancy and the elderly. The UK does not have a powder egg plant and 30% of the processed egg market is imported.

With concerns about environmental and financial impact of transport, provenance has become a more important issue in food production. We have everything required in the UK to produce and market eggs locally.

For egg consumption to increase we must think “put an egg on it”.

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## **DISCLAIMER**

The opinions expressed in this report are my own and not necessarily those of the Nuffield Farming Scholarships Trust, or of my employer, or of my sponsor, or of any other sponsoring body.

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## 1. Personal introduction

Although not from a farming background, I've always had a keen interest in agriculture. Growing up outside Peebles in the Scottish Borders, it would be hard not to develop a connection with the beautiful countryside!

Having graduated in Business Management with Marketing in 2006, I embarked on a new career in the poultry industry.

As an assistant farm manager with no previous experience, I learned my trade at Glenrath Farms Ltd. After a steep learning curve, I soon learnt the value and importance of good stockmanship, and working together to get the best out of the team. This job was not only rewarding but also provided me with an excellent grounding in the egg industry.



Figure 1: The author, Jamie McIntosh

Since 2012 I've been a regional technical manager for Lohmann GB which supplies day old chicks to egg producers throughout the UK and Ireland. I'm responsible for maintaining and increasing sales of the Lohmann bird in Scotland and the North of England. Of equal importance is the technical support I provide - not only to the rearing companies but also to their own customers who buy POL pullets from them. My role is varied and enjoyable - from a hands-on approach with deliveries of chicks and pullets; to monitoring and working with farmers to get the best out of the bird; to meetings discussing new orders, placements and technical issues.

In my free time sport and keeping fit are my personal challenges. When time allows, I ski in the winter, golf in the summer and play squash all year round.

I am lucky in my fantastic network of friends, family and colleagues who have supported me and have made the task of juggling a demanding day job with a Nuffield Farming Scholarship that bit easier.

I'm very grateful to The MacRobert Trust for sponsoring my Nuffield Farming Scholarship, which has proven to be a most rewarding and worthwhile experience.

*Explore new ways eggs can be marketed to maintain a steady increase in egg consumption ... by Jamie McIntosh.*

A Nuffield Farming Scholarships Trust report ... generously sponsored by The MacRobert Trust



## 2. Background to my study

The Aim of this report is to

- Highlight potential benefits from an increase in egg consumption
- Identify different ways of marketing eggs learned from my visits
- Suggest how we might extrapolate marketing ideas to adopt into the UK market

As this report centres on the marketing of the humble egg I think it would be beneficial:

### 2.1. To explain what marketing is:

*“the action or business of promoting and selling products including market research and advertising”  
(Dictionary.com, 2019)*

Another simple way to examine the key elements of effective marketing is to consider the marketing mix. Also known as the 4 P's, they are:

- Product
- Price
- Promotion
- Place (*E J McCarthy, 1960, www.wikipedia.org*)

Instrumental to egg consumption is the producer; the hen! - the world's most populous bird (19.5 billion chickens producing 1.1 trillion eggs per year). (*Gresser, 2012, www.progressive-economy.org*). Her ancestors are the red and grey junglefowl (*Gallus gallus*) originating from the jungle (Himalayan foothills). This became a domestic chicken (*Gallus gallus domesticus*) used as a food source for meat and eggs for at least 5400 years. (*Storey A.A et al 2012, www.ncbi.nlm.nih.gov/pmc/articles/PMC3405094*).

Following decades of successful breeding programmes after the Second World War, today the chicken is bred for either meat as a broiler, or for eggs as a laying hen. Layer breeding programmes have dramatically improved the efficiency of the bird which has continued to become more productive and healthier. New techniques for selection, such as genomics testing, mean there is considerable potential for better efficiencies in the future to support a burgeoning population with diminishing resources.



## 2.2. The egg

- eggs are highly nutritious, versatile, and a cheap source of quality protein
- although increasing, egg consumption in the UK at 199 eggs per capita is below that of Denmark, Spain, France and Germany who are closer to, or exceed, 250 eggs per capita; and markedly behind the highest egg consuming countries in the world which include Mexico, Japan and Russia who are all consuming over 300 eggs per capita.

*(International Egg Commission, 2019)*

In the 1960s, the UK egg industry championed the “Go to work on an egg” campaign. Following a peak in the mid 1970s, a slow decline followed over the next two decades with concerns over cholesterol consumption and salmonella poisoning. The market crashed in 1988 when Edwina Currie controversially voiced concerns over salmonella existing “*in most eggs*”, which catastrophically shattered confidence in the product.

Despite a successful campaign from the British Egg Industry Council (BEIC) to promote food safety with the Lion trademark in 1997, and positive health messages from numerous medical professionals, eggs have a long way to go before they reach their sales potential compared to the countries cited above.

I wanted to find out new ways of how to increase egg consumption nearer to those levels.

Let’s look at why egg consumption should increase.

## 2.3. Health crisis

A key driver for me in finding new ways of increasing egg consumption has been to support efforts to improve the health and wellbeing of our nation.

That the UK is facing a major health crisis in many respects is not in doubt. Obesity rates and the number of people who are overweight have increased significantly in the past 25 years.

Fifteen % of the UK population were classed as obese in 1993. In 2018 this figure had increased to 26%. (*NHS statistics team, 2018, [www.digital.nhs.uk/data-and-information/publications/statistical/statistics-on-obesity](http://www.digital.nhs.uk/data-and-information/publications/statistical/statistics-on-obesity)*). This is associated with rising levels of Type 2 diabetes, heart disease and other cardiovascular illnesses. Cardiovascular diseases are the number one cause of death globally. (*World Health Organisation, 2017, [www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases](http://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases)*)

Perhaps more concerning is that an estimated 34% of children in England are overweight or obese by the age of 11. That’s 1 in 3!! (*Obesity statistics, [www.researchbriefings.parliament.uk](http://www.researchbriefings.parliament.uk), 2018*).



Studies have found that a moderate level of egg consumption is linked to a lower cardiovascular event rate (*British Medical Journal*, 2018, [www.bmj.com/company/newsroom/daily-egg-consumption-may-reduce-cardiovascular-disease/](http://www.bmj.com/company/newsroom/daily-egg-consumption-may-reduce-cardiovascular-disease/)). The study, of over half a million adults, compared daily egg consumers with those who weren't consuming eggs. Those eating an egg a day could reduce their risk of stroke by 26%.

Statistics show there are now 3.7 million people with diabetes, double the 1.9 million there were in 1998. Last year, those diagnosed with diabetes increased by almost 100,000. A further 12 million are at risk of developing Type 2 diabetes (Diabetes UK, May 2019, [www.diabetes.org.uk/about\\_us/news/diabetes-prevalence-statistics](http://www.diabetes.org.uk/about_us/news/diabetes-prevalence-statistics))

Type 2, which accounts for 90% of all those diagnosed with diabetes, is caused by spikes in the levels of glucose in the blood becoming too high. The GI (Glycaemic Index) is a measure of how foods impact the level of glucose in the blood. The higher the score, the greater the risk of a spike in these levels, which increases the risk. Processed foods that are high in carbohydrates can be higher risk. As eggs contain almost no carbohydrates, they have a very low GI score so are very suited to those who have diabetes.

*"An Egg a Day Keeps Diabetes Away"* ([www.mindfood.com](http://www.mindfood.com), Jan 2019)

Heart and circulatory disease accounts for around 30% of all deaths globally and diet is highlighted as a major contributory factor ([www.heartuk.org.uk/about-us/media](http://www.heartuk.org.uk/about-us/media)). The British Heart Foundation and Heart UK have no recommended limit on the number of eggs that can be eaten in a week ([www.bhf.org.uk](http://www.bhf.org.uk), [www.heartuk.org.uk](http://www.heartuk.org.uk))

Slimming World recognises the value of eggs in a balanced diet, citing it as a *"sin-free food"* accounting for only 75 calories per egg. (*Slimming World*, UK)

Mental health problems - including anxiety, depression and eating disorders - are an area of significant concern impacting on the wellbeing of people in the UK. Mind, a charity that provides support and advice to those battling mental health issues, estimates 1 in 4 people are experiencing a mental health problem every year. The relationship between mental health and nutrition is cited as one of the most obvious but most under recognised. ([www.mind.org.uk/information-support/](http://www.mind.org.uk/information-support/))

In a study where pregnant women were given a daily choline supplement equivalent to what 3 large eggs would provide, it was found choline could reduce the risk of young infants developing schizophrenia. Choline levels in the diet have recently fallen and egg yolks are one of the best sources for choline - *"jampacked with great nutrients for the brain"*. (*Deans, Psychology Today*, 2013, [www.psychologytoday.com/us/blog/evolutionary-psychiatry/201302/eat-your-egg-yolks](http://www.psychologytoday.com/us/blog/evolutionary-psychiatry/201302/eat-your-egg-yolks))



So it can be seen that, although today's health-related conditions are complex and often difficult to tackle, the right nutrition is of paramount importance to prevention and cure.

I was keen to see how the humble egg, possessing such nutritive robustness, can play a bigger part in the efforts to tackle and reverse these trends.

The ongoing improvements in genetics, welfare and an ever-reducing carbon footprint make this an ideal food for consumption growth.

I wanted a Nuffield Farming Scholarship to find out how other countries managed to have such high *per capita* levels of egg consumption. In the next chapter I detail the countries I visited in pursuit of this knowledge.

\*\*\*\*\*

#### **A UK Nuffield Farming Scholarship consists of:**

- (1) A briefing in London.
- (2) Joining the week-long Contemporary Scholars' Conference attended by all new Nuffield Farming Scholars worldwide, location varying each year.
- (3) A personal study tour of approximately 8 weeks looking in detail at the Scholar's chosen topic.
- (4) A Global Focus Tour (optional) where a group of 10 Scholars from a mix of the countries where the scheme operates travel together for 7 weeks acquiring a global perspective of agriculture.

\*\*\*\*\*

The Nuffield Farming Scholarships scheme originated in the UK in 1947 but has since expanded to operate in Australia, New Zealand, Canada, Zimbabwe, France, Ireland, and The Netherlands. Brazil, Chile, South Africa and the USA are in the initial stages of joining the organisation.



### 3. My Study Tour: where I went and why

Country	Date	Reason for choosing to visit
<b>COLOMBIA</b> Annual consumption: 279 eggs per capita	May 2018	Has had an increase of 80+ eggs per capita in the past 10 years. I wanted to study the reasons why
<b>USA</b> 276 eggs per capita	June 2018	Despite a recent Avian Influenza outbreak and a shift away from the cage production system, egg consumption in the USA is thriving. Why such resilience and how can they increase consumption higher?
<b>CANADA</b> 242 eggs per capita	June 2018	Canada has a unique quota system to control egg supply. Egg consumption is rising and higher than in the UK. It was interesting how supply, demand, consumption trends and increases worked here.
<b>POLAND</b>	September 2018	Meeting with egg scientist Fabien De Meester.
<b>DENMARK</b> 245 eggs per capita	September 2018	Denmark has a strong organic product demand but how sustainable and successful is it? The Danish egg market was also where I wanted to find out more about branding.
<b>ITALY</b> 215 eggs per capita	October 2018	Committee for World Food Security at the Food and Agriculture Organisation Headquarters in Rome. An opportunity to learn about world food issues, the imbalance of nutrition and the impact of the CFS on policy within all 193 UN member states. I gained a wider understanding of the benefits of egg consumption on a global scale, impact of egg production on the environment and how vital communication is.
<b>CHINA</b> 307 eggs per capita	January 2019	China is the world's largest egg producer, and at over 300 eggs per capita is one of the largest consumers.
<b>JAPAN</b> 333 eggs per capita	January 2019	At 335 eggs per capita, Japan is among the world's highest egg-consuming countries. I was particularly interested in enriched eggs and how eggs fitted in to the catering and processing sectors.



## 4. Realising the potential

### 4.1. Building on success

The egg, designed by nature to nurture the developing chick, has the nutritional capabilities and protective layers to create life. There are of course many other highly nutritious foods, but I can't think of one that can compete with the egg as a whole package.

Yet egg consumption in the UK is only just exceeding the levels seen in the late 1980s pre the salmonella crisis. The salmonella crisis happened when leading politician Edwina Currie publicly claimed salmonella *"was present in most eggs"*. The remarks were damaging and widely overstated and had a dramatic impact in consumer confidence leading to a sharp decline in egg consumption. There was some truth in what she said: the egg industry did have a problem with salmonella at that time.

The industry worked hard to turn the situation around and in 1998 the BEIC introduced a Code of Practice for the Lion Scheme. All Lion-registered eggs had to be vaccinated against *salmonella enteritidis*, date stamped, and be from British farms. Since then, the number of salmonella outbreaks has fallen sharply and reported cases of illness have decreased significantly.

For egg consumption in the UK to increase, we need a solid base to consolidate consumer confidence. Nowadays, the Lion is widely recognised as a trademark of food safety. Lion-registered eggs now account for over 90% of all UK eggs and many new standards have been introduced since it was established in 1998: including full traceability throughout the supply chain (breeding farms, hatcheries, rearing and laying farms, feed mills and packing centres); time and temperature controls for eggs on farm; extensive salmonella sampling; testing on turnaround of flocks; and hygiene controls in packing stations. This is backed up by regular independent auditing. Many people I met round the world commented on how successful the Lion Scheme in the UK is, and that it is something they aspire to. The Lion is seen as the benchmark of food safety. **(See Appendix 1)**

The Fipronil scandal was a recent example of how important the Lion scheme has become. In 2017, Fipronil, a banned insecticide, was used in some poultry houses in the Netherlands and, as a result, some eggs were contaminated. A percentage of these were exported all over Europe and Asia. During the scandal, the Lion scheme was able to confidently say that all Lion-registered eggs were completely unaffected.

The UK has a robust and food-safe egg industry. It offers the consumer a choice of production system (cage, barn, free range or organic), is adaptive to change and constantly evolving to meet consumer demands and expectations.





Good welfare standards are of paramount importance to egg producers in the UK and they adhere to welfare conditions that exceed levels seen almost anywhere else in the world. Constant environmental improvements for the hen are being made such as reductions in stocking density and increased nest box, feed and water drinker space. Shortly, the industry is likely to adhere to a ban on beak trimming and research is underway to identify male embryos early in the incubation phase with a view to eradicating the need to hatch a male chick. Currently male chicks in the egg industry are euthanised at day old.

Eggs have also seen the carbon footprint they create significantly reduce since the 1950s. Selective breeding techniques from the layer genetics companies, improvements in housing, and animal husbandry have contributed.

#### 4.2. Where are we now?

In recent years, fewer concerns about eating eggs have been voiced. British Heart Foundation's recommended upper egg consumption limit has been dropped and the FSA (Food Standards Agency) has also changed their advice: infants, children, pregnant woman and elderly people can safely eat raw and lightly cooked eggs that are produced under the Lion scheme.

What impact has this had on growth? We are consuming 199 eggs per capita. As seen below the trend has been good since the early 2000s.

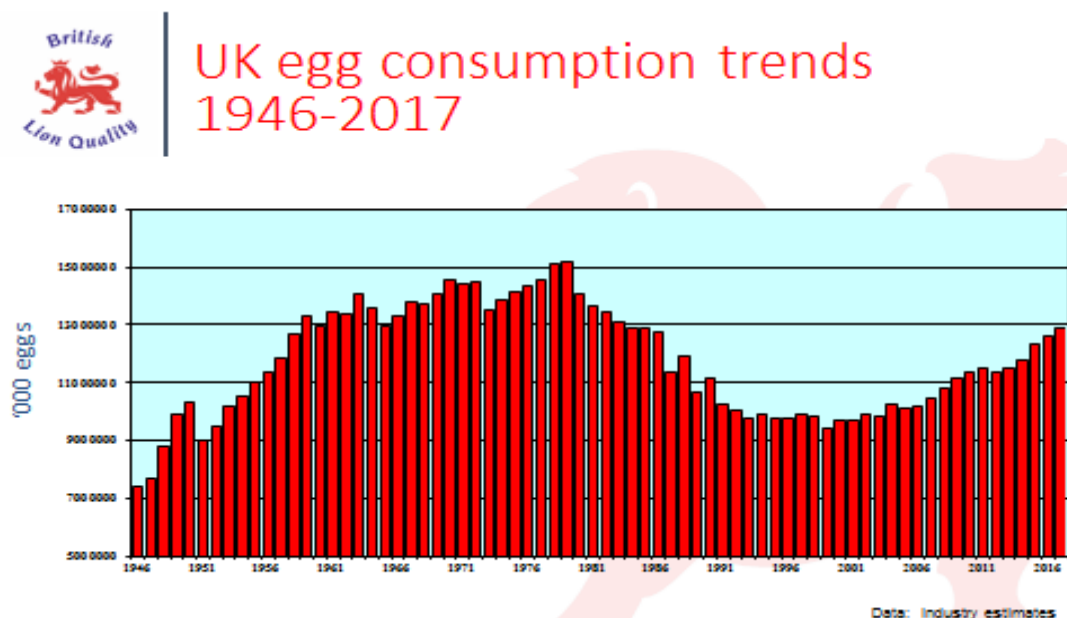


Figure 2: BEIC Consumption Growth. Source: BEIC, Aug 2018





We can see that consumption peaked in the 1970s, then dramatically fell through the 1980s and 1990s, but has shown a steady rise since. The graph below illustrates how we compare to other countries.

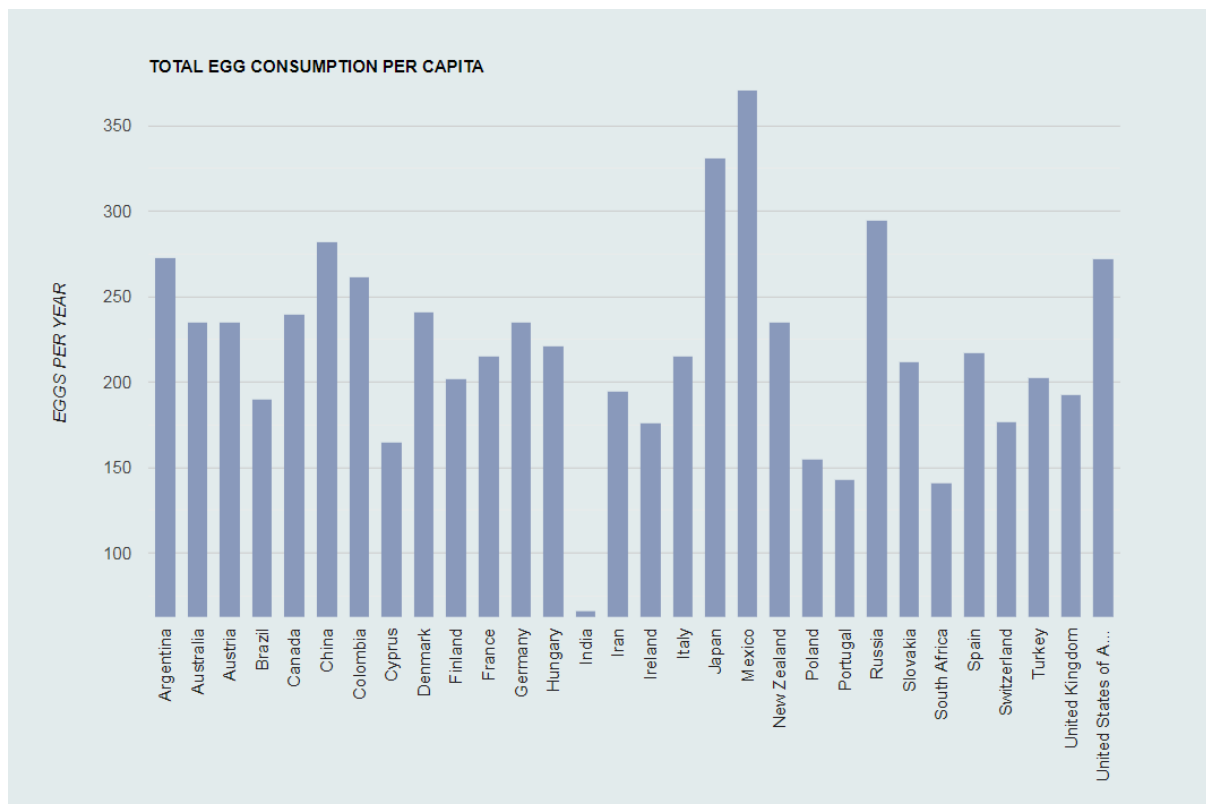


Figure 3: Total egg consumption per capita in various countries of the world. Source: International Egg Commission

Whilst consumption in the UK is increasing, this list of 30 countries shows that, nevertheless, the UK sits in the bottom third.

### 4.3. Future potential

Can we improve our standing? I will now explore examples of what has happened with consumption - and an outline of how it has been achieved - in some of the countries I visited: Canada, USA and Colombia.

#### 4.3.i. Canada

*Please see chart on next page*

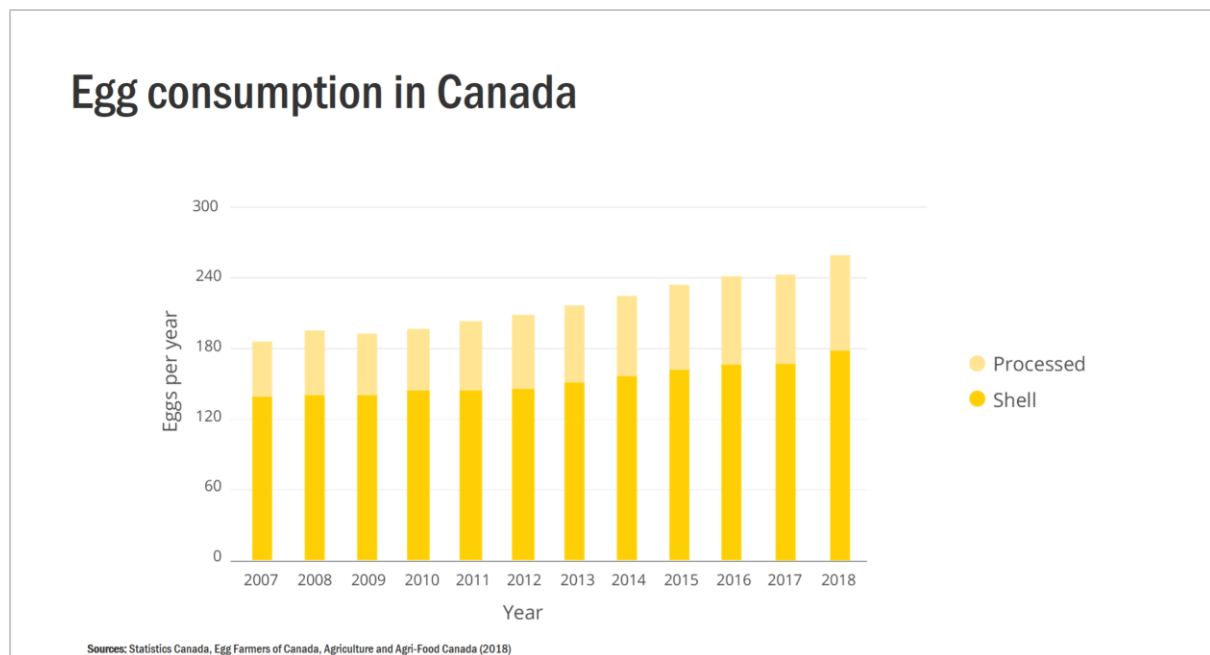


Figure 4: Dozen per capita increase in Canada 2007-2017. Source: EFC 2018

Egg Farmers of Canada (EFC) is a government-led department representing the egg industry. Canada has a quota system for the egg market. This enables EFC to control imports. Only once all 10 provinces have cleared their egg markets will EFC consider importing. The system also regulates expansion, and works by bird allocation tickets which farmers can bid for.

The graph above shows the breakdown of how egg consumption has increased in terms of shell, processed and total egg. Per capita consumption increased 24% in 10 years to 239 eggs per person.

EFC sees its core role as promoting eggs and has a 5-pillar programme for sustainability that has helped promote egg consumption. The pillars are: Food Safety, Animal Welfare, Environmental Sustainability, Enhancing the public and Empowering the people.

#### 4.3.ii. Colombia

Colombia has seen remarkable progress in consumption over the past 10 years. In percentage terms, it's an almost 45% increase per person!

*see chart on next page.*

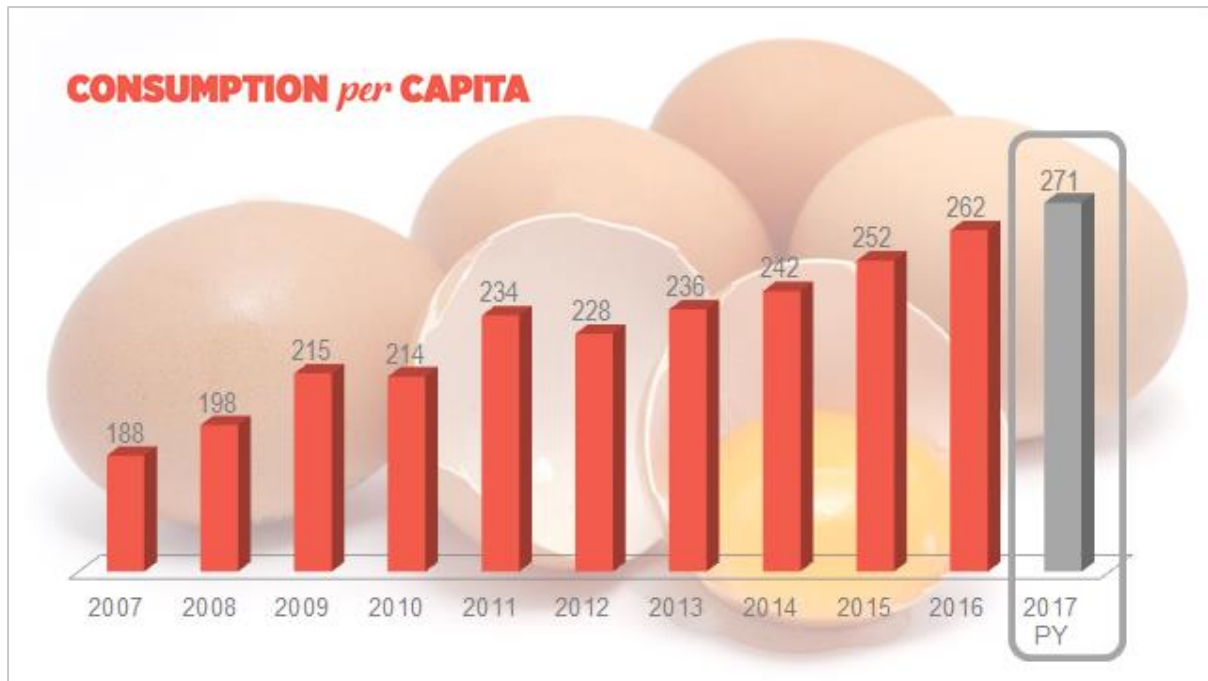


Figure 5: Consumption of eggs per capita in Colombia 2007-2017. Source: Fenavi, May 2018

Colombia was the first place I visited on my Nuffield Farming study tour in May 2018. I soon realised how much of an impact a focused marketing campaign could have on increasing consumption. This included TV, radio and digital outreach programmes.

Santa Reyes, a large egg producer on the outskirts of the Colombian capital, Bogota, has embraced this. Juan Pablo, director at Santa Reyes believes “*an egg is not just an egg*” and that the big challenge is getting people to believe in the benefits of eating them.

#### 4.3.iii. The USA

The US egg market has recently experienced the worst disease outbreak in its history. In 2015, Avian Influenza wiped out around 50 million laying hens and turkeys, the hens accounting for approximately 12% of the total table-egg laying population (USDA, [www.ers.usda.gov](http://www.ers.usda.gov)). Egg consumption fell slightly in 2015 but as shown in the graph below, made a strong recovery in 2016.

The American Egg Board (AEB) suggests we should focus on the consumer differently to increase sales. The graph below illustrates consumption trends in the US.

*see table on next page*

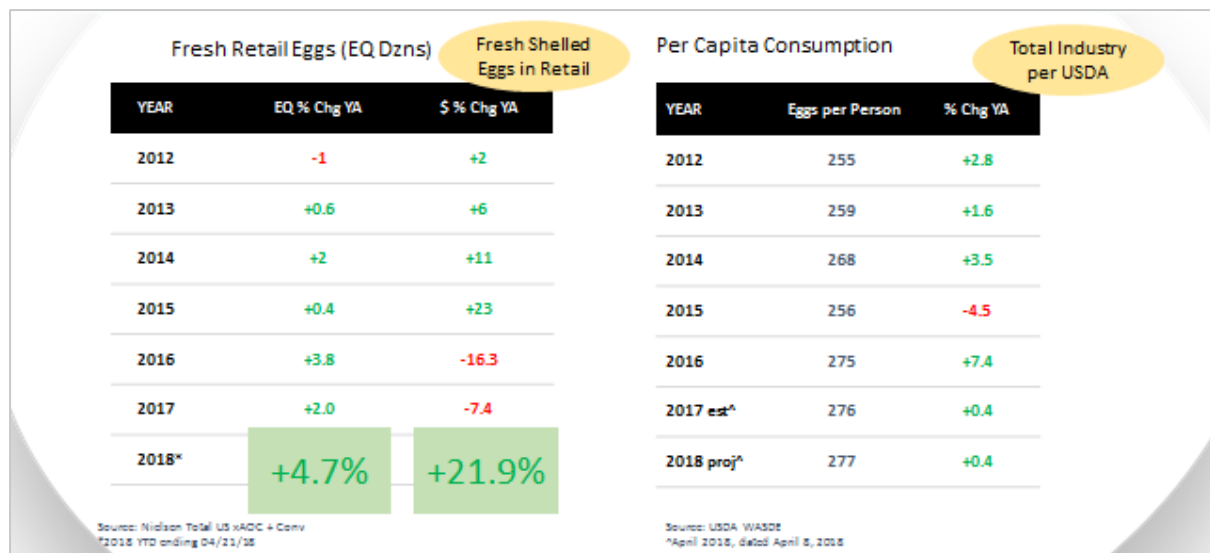


Figure 6: USA egg consumption figures. Source: American Egg Board, June 2018

#### 4.4. Chapter Summary

- The Lion scheme provides a solid base from which to build egg consumption
- Egg consumption in the UK falls behind that of many other countries
- Canada, Colombia and the US have all seen stronger growth in recent years



## 5. Threats we must consider

### 5.1. Through the consumer's eyes

Today's consumer of food and drink is bombarded with an array of conflicting information on health, food safety, interpretations on animal welfare, and provenance. Taste, attractiveness of packaging, advertising and environmental credentials all impact on the decision-making process, along with the all-important retail sale price.

David Hughes, a Professor of Food Marketing at Imperial College London, delivered a presentation I attended in March 2018. He spoke about a mega consumer trend: mindful choices. Now, with more information than ever before, and a more limited time span to capture the consumer's attention, we need to ensure our messages are evidence-based and both clear and concise.

Eggs have attracted mixed publicity since the 1950s. It has swung from one extreme to the other.

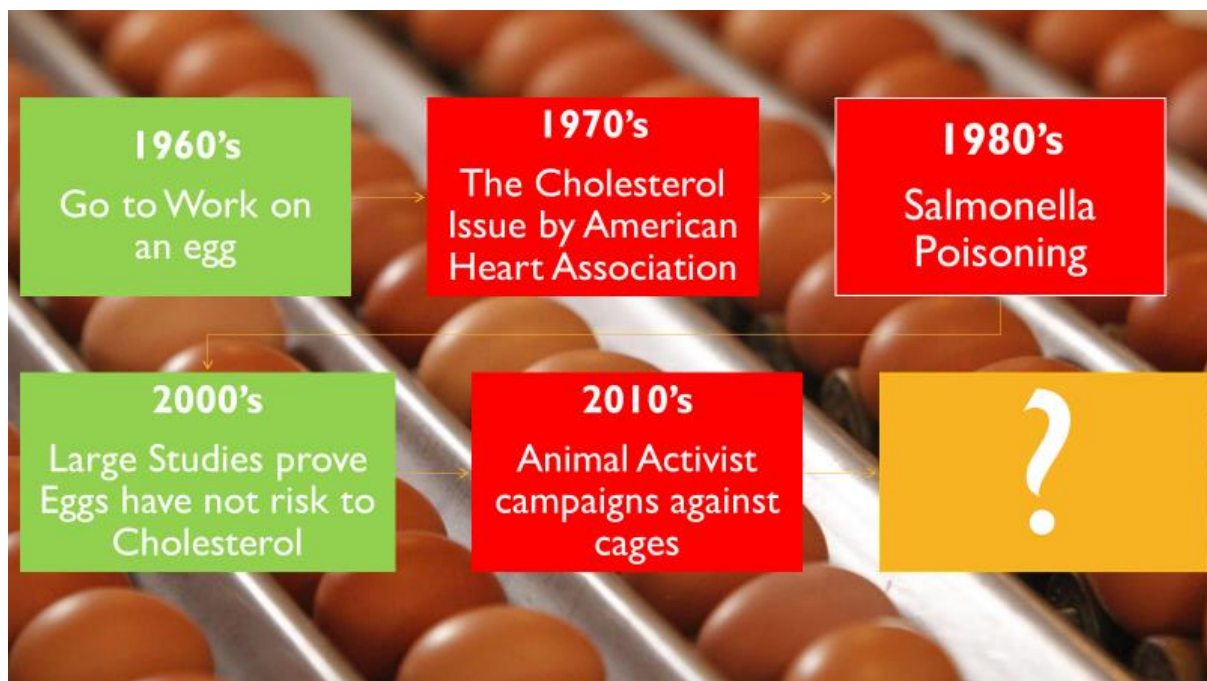


Figure 7: Various publicity campaigns associated with eggs since the 1950s: Source: Carlos Saviani

Carlos Saviani, who was presenting at the IEC Conference in Monaco, April 2019 put it this way: “Egg; hero or villain”. (Carlos Saviani, food sustainability and marketing executive).

**See Appendix 2**



Figure 8: “Unreplaceable Egg: there is no substitute”. Source: Carlos Saviani presentation

Carlos, who was overwhelmingly positive about the future of eggs, posed the question: “*Could eggs now be villainised because of their environmental impacts?*”. This is perhaps something we should be preparing for in the UK.

Seismic shifts between “good” and “evil” in various media headlines have portrayed mixed messages to the consumer, many unsure about whether eating eggs is the right choice for them. In medicine and industry, due to extensive research, cholesterol levels in eggs are now widely recognised as low risk to human health, thus reversing advice to the contrary in the 1970s. Despite this, I’ve learned that this message is not getting through, and not just in the UK.

Ghen Corporation, a layer genetics company in Japan, told me that a recent government study found that 80% of Japanese consumers didn’t know that cholesterol in eggs was no longer considered a health concern. The egg industry in the UK faces a similar problem. Guidance can be misleading, and the correct information is often not reaching the consumer.

Welfare groups can have a significant impact on purchasing power too. Peta, the largest animal rights organisation in the world, have attracted more than \$50 million dollars to fund campaigns highlighting animal suffering in laboratories, the food industry, clothing and the entertainment industry. They have recorded over 500 million views on their websites, which have featured hard hitting investigations and celebrity adverts. This organisation (Peta) along with others has repeatedly exposed the egg industry for malpractice and welfare



compromises, through representatives working undercover plus farm break-ins. Peta and other highly organised welfare groups can have a substantial impact on consumer decisions.

Another trend is the movement towards plant-based diets. In the latest EAT Lancet report (*see Appendix 3*) published January 2019 by 30 worldwide scientists from different areas around the globe, a shift away from what they describe as “unhealthy foods” such as red meat, sugar and refined grains, towards a diet with more vegetables, wholegrains and nuts, was suggested. This diet is largely vegan and the article claims it would be most beneficial to the planet. The worry for the egg industry is the report recommends only 1 or 2 eggs weekly.

The EAT Lancet commission is a non-profit start-up that claims to be dedicated to reaching scientific consensus that defines a healthy and sustainable diet to feed a future population of 10 billion people.

Reaction to this report has been controversial. Whilst it’s widely accepted a radical transformation of the global food system is required, academics in nutrition and agriculture have heavily criticised the report’s recommendations. Geraldine McNeill, a professor of Global Nutrition and Health, believes the recommended diet may not apply in practice; wondering what impact changing production methods for livestock would have on the report’s conclusions.

Diet options are vast: consumers can choose to be a plant-based vegan, vegetarian, pescitarian, flexitarian and reducitarian to name a few. Veganism, a term coined by David Watson in 1944 ([www.wikipedia.org/wiki/Veganism](http://www.wikipedia.org/wiki/Veganism)) has become far more mainstream. 2019 is “the year of the vegan” and in America “fully a quarter of 25 to 34 year olds say they are vegans or vegetarians” (The Economist, 2019, see: [www.worldin2019.economist.com/theyearofthevegan](http://www.worldin2019.economist.com/theyearofthevegan)).

In the same year, provided the Pope agrees to go vegan for Lent, Million Dollar Vegan have pledged a \$1 Million donation to the charity of his choice ([www.change.org/p/ask-pope-francis-to-fight-climate-change-with-diet-change](http://www.change.org/p/ask-pope-francis-to-fight-climate-change-with-diet-change), 2019). Fortunately, there’s also an alternative vegan diet that includes eggs: the “veggan” diet.

But eggs must also compete with the lure of many fast food and food-to-go options which, despite often having too much sugar, salt and trans fats, sell very well. Cost, great taste and convenience are enabling these foods to thrive.

## 5.2. Rise of the alternatives

Closely linked to the shift towards plant-based foods are animal alternative products, which have gained traction at a rapid pace in recent years. From a moral and religious perspective, views on what and how animal-derived foods can be consumed have been restrictive mainly





with religious groups, for centuries. Today views have moved on, “animal-free” becoming more mainstream.

Extensive research and development have gone into developing plant-sourced proteins that closely mimic the equivalent animal protein in terms of taste, texture and nutrient value.

Plant-based alternatives to eggs, meat produce, cheese, milk, butter and even honey are available. Recently, alternatives to seafood have been developed including fish-free sushi, crab-free crab cakes, and fishless fillets.

I visited Just Inc in San Francisco, California. They manufacture and sell egg-free alternatives and are developing lab-grown cultured meat. Formed in 2011, Just Inc have so far raised over \$200 million dollars of funding, are ambitious and aim to have *“the widest impact as fast as possible”*.



Figure 9: Egg-free mayo manufactured by Just Inc. Source: author's own

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Using mung bean for protein, Just Inc have created a range of products that include egg-free mayonnaise and salad dressings, cookie dough and Just Scramble (*see picture below*).

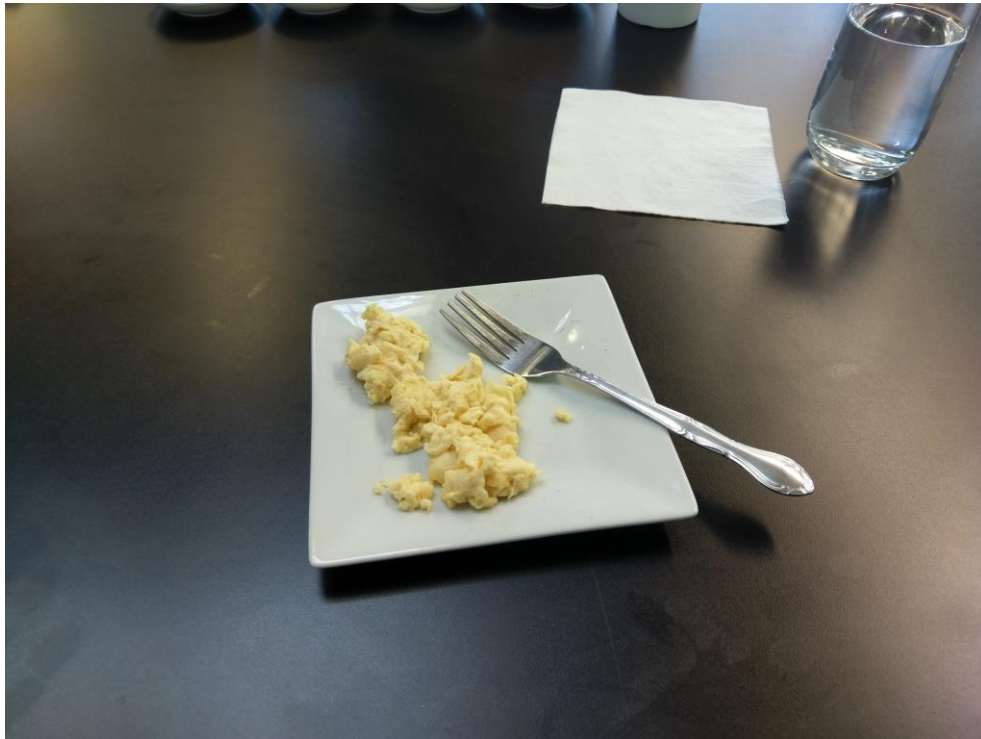


Figure 10: Egg-free scrambled egg by Just Inc. Photo author's own

As can be seen, the texture is similar and, with sulphur added, it gave an egg-like taste and smell. Although mung bean is high in protein content the full nutritive benefits of these products were unknown. Whilst impressive, it's still unclear whether there is scope for upscaling production.

What struck me about this company was how driven it was to succeed. In the team of over 150 employees, there are 5 Michelin-star chefs and several biochemists who are committed to product development. Of over 1000 species of plants available, less than 1% have been tested so far.

Beyond Meat and Impossible Foods are two other companies producing meat-free alternatives. The Impossible Foods burger has become very popular in the US and, after partnering with multiple fast food restaurants and chains, is struggling to keep up with demand. ([www.cnet.com/news/the-impossible-burger-is-demand-outrunning-supply/](https://www.cnet.com/news/the-impossible-burger-is-demand-outrunning-supply/), 2019)



### 5.3. Industry challenges

The egg industry faces ongoing threats that could impact on future success. Disease control, improvements in bird welfare, NGOs and government policy demands, adhering to food safety standards and reducing the environmental impact - are all key areas.

Controlling disease is a constant battle and fundamental to maintaining a healthy flock of hens. Many of the common diseases in poultry can be vaccinated for, with reasonable success. One that can't be protected against is Avian Influenza. In 2016 and 2017, AI struck in Europe. It wiped out several laying flocks in multiple countries and was deemed serious enough for the Chief Veterinary Officer to impose a housing order for free range flocks in the UK. This lasted from December 2016 to April 2017, causing concern from a marketing perspective as, for eggs to be sold as free range, birds were expected to have access to a range outside.

Good welfare practice is of paramount importance for both looking after the wellbeing of the flock and to achieve good performance: they go hand-in-hand. As the consumer becomes more disconnected from the food production systems they rely on, perception of what good welfare is has become harder to define.

Despite this, it is one of the key drivers for change in the egg industry. After a move away from the conventional cage by 2012 (legislated by an EU directive), and despite considerable investment in 2019, the industry is facing another colossal shift: this time away from the enriched cage towards non-cage systems. Pressure from groups including animal rights activists has forced a commitment from all major retailers to stop selling eggs produced in a cage by 2025 or earlier.

A prominent welfare topic is the imminent ban on beak trimming expected to be enforced by government soon. Beak trimming is carried out on a day-old chick by an infra-red laser beam as a prevention measure for when they are older. Hens with full beaks are likely to cause damage to other birds in situations of stress, which can lead to an outbreak of cannibalism in the most serious form. However, the practice of beak trimming is viewed by many as a mutilation and an unnecessary compromise on welfare for the chick - despite the possible repercussions later in the bird's life.

Another challenge is a possible future ban on the culling of male chicks in the egg production industry. They are currently euthanised at day old using argon gas and there is a strong demand for these chicks in other markets such as reptile centres and zoos. As these chicks will not lay eggs and are not financially viable to rear for meat production, this is currently the most efficient method.

From a welfare perspective, it's seen as unacceptable to many. In Germany, a ban is already in place and, if hatched in that country, the male chicks must be kept (uneconomically) for



meat production. Another option is to determine the sex of the chick whilst still in the egg, which is not yet commercially viable and associated costs are unknown.

The egg industry has maintained an excellent record for food safety, but ensuring prevention of food scares or scandals is perhaps the most important challenge going forward. And especially now, when news stories can reach anyone at any time, there is no hiding place.

The Fipronil scandal already mentioned highlights the potential risks to food safety in intensive farming.

The Chinese milk scandal in 2008 was another food safety incident that had serious consequences for the milk industry in China. Infant formula was contaminated with melamine which gave the appearance of higher protein content when added to the milk. Over 50,000 babies were hospitalised and 6 died from kidney damage as a result. ([www.wikipedia.org/wiki/2008\\_Chinese\\_milk\\_scandal](http://www.wikipedia.org/wiki/2008_Chinese_milk_scandal)). The egg industry must take note.

### 5.5. Chapter Summary

- Consumers are faced with mixed messages: on welfare, food safety and health benefits of eating eggs
- Plant-based egg and meat alternative companies are experiencing rapid growth
- There are ongoing threats to consumption including breaches in food safety, disease outbreaks and changes in legislation



## 6. Comprehensive health cover

### 6.1. Nature's nutrient giveaway

The egg is “an animal reproductive body consisting of an ovum (egg cell) together with nutritive and protective envelopes, having the capacity to develop into a new individual capable of independent existence” ([www.merriam-webster.com/dictionary/egg](http://www.merriam-webster.com/dictionary/egg))



Figure 11: Chick hatching. ([www.motherearthnews.com](http://www.motherearthnews.com))

The egg has all the nutrients required to support a chick.

Energy is made up from protein, fat and carbohydrates. A study of popular fast foods and sit-down restaurant meals found high dietary energy content was widespread, thereby heightening obesity levels in the consumer. (Roberts *et al*, Dec 2018, [www.bmj.com/content/363/bmj.k4864](http://www.bmj.com/content/363/bmj.k4864)). Many meals exceeded 1000 kcal, some over 2000kcal, often containing too many refined carbohydrates and fats. Public Health England recommends a maximum of 600kcal per meal. ([www.gov.uk/government/news/plans-to-cut-excess-calorie-consumption-unveiled](http://www.gov.uk/government/news/plans-to-cut-excess-calorie-consumption-unveiled))

The WHO (World Health Organisation) Protein Digestibility-Corrected Amino Acid Score (where 1 is the highest and 0 the lowest) is based on the amino acid requirement of humans and their ability to digest it. Eggs have a score of 1, putting them in the highest group.

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An egg contains all 9 of the essential amino acids the human body cannot synthesise:

- histidine
- isoleucine
- leucine
- lysine
- methionine
- phenylalanine
- threonine
- tryptophan
- valine

Shortages of any one of these leads to protein deficiency which can affect all the body's organs, impacting on brain function and the immune system. ([www.wikipedia.org/wiki/Egg\\_as\\_food](http://www.wikipedia.org/wiki/Egg_as_food)).

High quality protein is beneficial for controlling and satisfying appetite, and feeling fuller for longer. At around 75 calories, the egg is an ideal food for weight management. **(See Appendix 4 for the Satiety List)**

An egg also contains **essential vitamins**:

- Vitamin A
- Thiamine (B1)
- Riboflavin (B2)
- Niacin (B3)
- Pantothenic acid (B5)
- Vitamin B6
- Folate (B9)
- Vitamin B12
- Choline
- Vitamin D
- Vitamin E
- Vitamin K

**and Minerals:**

- Calcium
- Iron
- Magnesium
- Phosphorus
- Potassium
- Sodium (continued overleaf)

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- Zinc

**and Antioxidants** (important for reducing oxidative damage in cells):

- Lutein
- Zeaxanthin
- Iodine
- Selenium

The above can be found naturally or by enriching the hen's diet.

(see [www.egginfo.co.uk](http://www.egginfo.co.uk), [www.eggnutritioncenter.org](http://www.eggnutritioncenter.org) )

Research from the 1970s highlighted cholesterol levels in eggs as a health concern. However now we know it is an essential nutrient of the body. Current studies, though, indicate that cholesterol is still perceived as harmful by the general public.

Cholesterol can be split into 2 categories: firstly that carried by LDL (low-density lipoprotein), considered “bad”, and secondly that by HDL (high-density lipoprotein), considered “good”. LDL carries the cholesterol to the arteries where it can deposit as plaque, and HDL transports the cholesterol to the liver where it is processed and excreted. Eggs can raise LDL levels, but HDL also rises at the same time, so the ratio of bad to good doesn't change. For most people, eggs do not significantly affect blood levels of total cholesterol and harmful LDL. (*Senior Dietician Victoria Taylor, [www.bhf.org.uk/what-we-do/news-from-the-bhf/news-archive/2015/may/eggs-and-cholesterol](http://www.bhf.org.uk/what-we-do/news-from-the-bhf/news-archive/2015/may/eggs-and-cholesterol)*)

## 6.2. Yolk as a “Mind” food

In September 2018 I discussed the importance of egg yolk with Fabien De Meester, (Belgian egg scientist).  
*“Yolk is brain fat and will feed the mind like a micro bioprocessor” and “Egg yolk is the best mind food by a long way,” he said.*

Nutrigenetics studies the link between the human genome, nutrition and health. Fabien discussed how a nutrient can interfere with (a) gene expression and (b) genetic makeup. He told me:

*“The human brain is rich in cholesterol which is 60% cell membrane lipids (the essential fats), omega 3 and omega 6. Egg yolk provides a balance of fats (which are triglycerides, phospholipids, cholesterol and xanthophylls) that is ideal for this.*



*Infant feeding is a particularly important area to encourage as currently less than 5% of infant feed comes from eggs. (Breast milk is high in brain lipids, including cholesterol)."*

### 6.3. The egg and its role for health conditions: reactive and preventative

The UK, as with much of the developed world, is battling major health conditions linked to overeating. Poor nutrition and dietary habits are the main cause. The nutritive capabilities and very low carbohydrate content of the egg can prevent such a negative impact on health and wellbeing.

The egg can act both in a preventative and therapeutic role in such illnesses. Six examples are shown in 6.3.i.-6.3.vi below.

#### 6.3.i. Choline during pregnancy

Good nutrition starts before birth. Some nutritional experts estimate that over 90% of pregnant women do not consume enough choline. A recent study (*Cornell University, Jan 2018, ([www.news.cornell.edu/stories/2018/01/adequate-choline-pregnancy-may-have-cognitive-benefits-offspring](http://www.news.cornell.edu/stories/2018/01/adequate-choline-pregnancy-may-have-cognitive-benefits-offspring) )* suggested that eating more choline-rich foods in pregnancy boosted babies' brain function. Choline is an essential nutrient important for memory function and healthy cells. Children of mothers given more choline in pregnancy showed significantly higher speeds of information processing at all ages. Egg yolks are rich in choline. ([www.nutraingredients.com/Article/2018/01/09/Dietary-choline-in-late-pregnancy-could-boost-babies-brain](http://www.nutraingredients.com/Article/2018/01/09/Dietary-choline-in-late-pregnancy-could-boost-babies-brain))



Figure 12: Choline for boosting babies brain power, [www.nutraingredients.com/Article/2018/01/09/Dietary-choline-in-late-pregnancy-could-boost-babies-brain](http://www.nutraingredients.com/Article/2018/01/09/Dietary-choline-in-late-pregnancy-could-boost-babies-brain)





### 6.3.ii. The first 1000 days

Research increasingly focuses on the importance of nutrition during pregnancy, birth and the first 2 years of life. Brain development is faster in this period than at any other time. (The Egg Nutrition Center's 2019 Winter Issue of its Nutrition Closeup features the article "Early Nutrition for lifelong health") *"it's the first 1000 days where good nutrition is most important. Along with choline, key nutrients in the first 1000 days are protein, polyunsaturated fatty acids, iron, zinc, copper, iodine, folate and vitamins A, D, B6 and B12. Eggs are a rich source of most of these nutrients."* ([www.eggnutritioncenter.org/science-education/nutrition/power-first-1000-days-early-nutrition-lifelong-health/](http://www.eggnutritioncenter.org/science-education/nutrition/power-first-1000-days-early-nutrition-lifelong-health/))

### 6.3.iii. Older people

Maintaining muscle mass becomes more difficult as people age. Sarcopenia is the degenerative loss of muscle mass, common for the over 50s. Due to high quality protein and vitamin D, egg consumption benefits those at risk of sarcopenia, (Smith A et al, 2016, [www.ncbi.nlm.nih.gov/m/pubmed/27270199/](http://www.ncbi.nlm.nih.gov/m/pubmed/27270199/) ). If the protein consumed is distributed throughout the day rather than in one meal, chances of maintaining muscle mass and strength increase.

### 6.3.iv. Vitamin D

Studies show many in the UK are not getting enough vitamin D, especially in the winter months. Symptoms include tiredness, weakness, muscle and bone pain. Eggs are one of the few foods that contain vitamin D. ([www.nhs.uk/conditions/vitamins-and-minerals/vitamin-d/](http://www.nhs.uk/conditions/vitamins-and-minerals/vitamin-d/))

### 6.3.v. Selenium

Selenium helps the immune system work properly and helps prevent cell and tissue damage. Those deficient in selenium are more likely to develop problems with fatigue and mental slowing ([www.nhs.uk/conditions/vitamins-and-minerals/others/](http://www.nhs.uk/conditions/vitamins-and-minerals/others/) ). Eggs can be enriched with extra selenium (see St Ewe's Boost the Roost pack in chapter 8).

### 6.3.vi. Type 2 Diabetes

Over 6% of the population are estimated to have diabetes: the majority, Type 2. The condition causes sugar levels (glucose) in the blood to rise dangerously. I visited David Unwin, a GP from Liverpool and an RCGP expert in diabetes. He has seen a reversal of T2D in many of his patients over the past 7 years. This has been achieved by altering his patients' diet by reducing not just sugar but the starchy carbohydrates that digest down into yet more sugar. He saw eggs as an ideal food as they have a high





nutrient density while containing almost no carbohydrates and so have a negligible effect on blood glucose while being very nutritious.

For example **see Appendix 5 on the last page of this report**

#### 6.4. Chapter Summary

- The egg is low calorie, highly nutritious and the yolk feeds the mind
- Eggs can be used to prevent and to treat several health conditions



## 7. Spreading the word



Figure 13: Most liked post on Instagram, [www.petapixel.com](http://www.petapixel.com) January 2019

Believe it or not, this egg holds the world record for the most likes on Instagram. With over 53 million “likes” as of May 2019, it surpasses everything else on the platform including posts by Kylie Jenner or Justin Bieber!

Despite this and ongoing good news stories about the health benefits of eating eggs, positive messages do not necessarily appear to reach the consumer.

### 7.1. American Egg Board (AEB)

The AEB works with US egg producers to execute coordinated programmes on research, education and promotion. I met AEB representatives John, who worked mainly with businesses in the food service industry and Sofia from “Consumer Engagement”.



Figure 14: John Howeth with the author. Photo: author's own

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### 7.1.i. The consumer

AEB spoke about different focuses on the consumer, splitting them into these groups:

- Millennials
- Multicultural (the fastest growing segment)
- The sporty or active lifestyle

They targeted groups through digital media campaigns, which changed monthly.

### 7.1.ii. AEB campaigns

- The Incredible, Edible Egg in the 1970s. A continued success with a comprehensive website, app and links to Disney's "Incredibles 2".
- 2018 – successful partnership with Disney enabled a themed campaign linking recipes with movie characters and associated "special powers". See photo below.

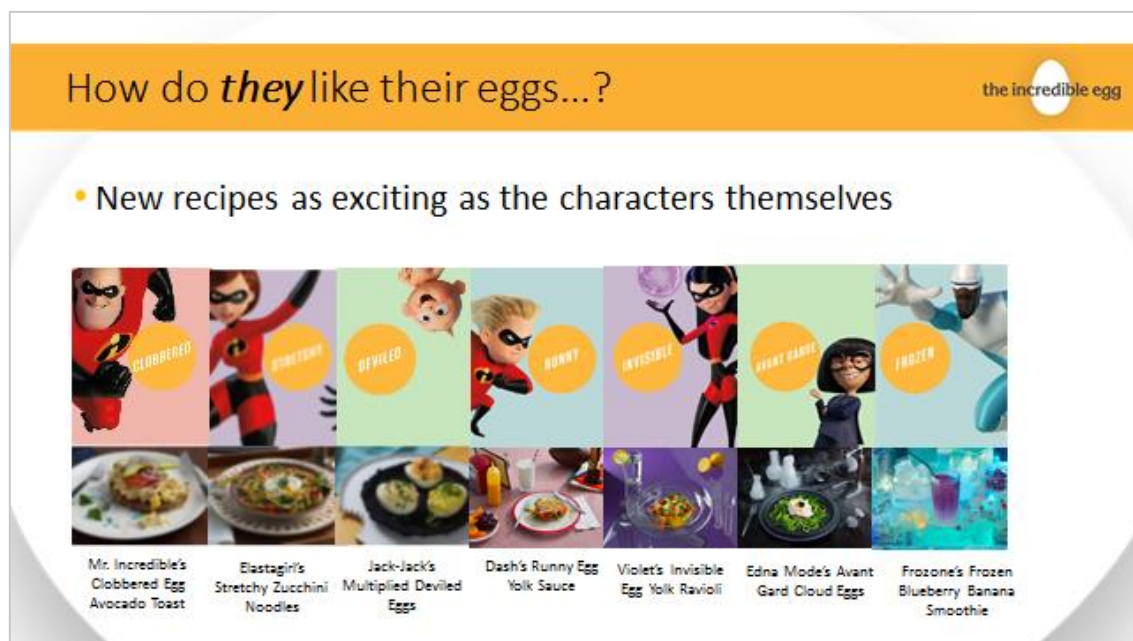


Figure 15: Incredibles 2 characters and eggs, American Egg Board June 2018

Launching this campaign in the summer of 2018, the anticipated effect was to reverse the traditional seasonal slump in summer sales.

*see graph on next page*

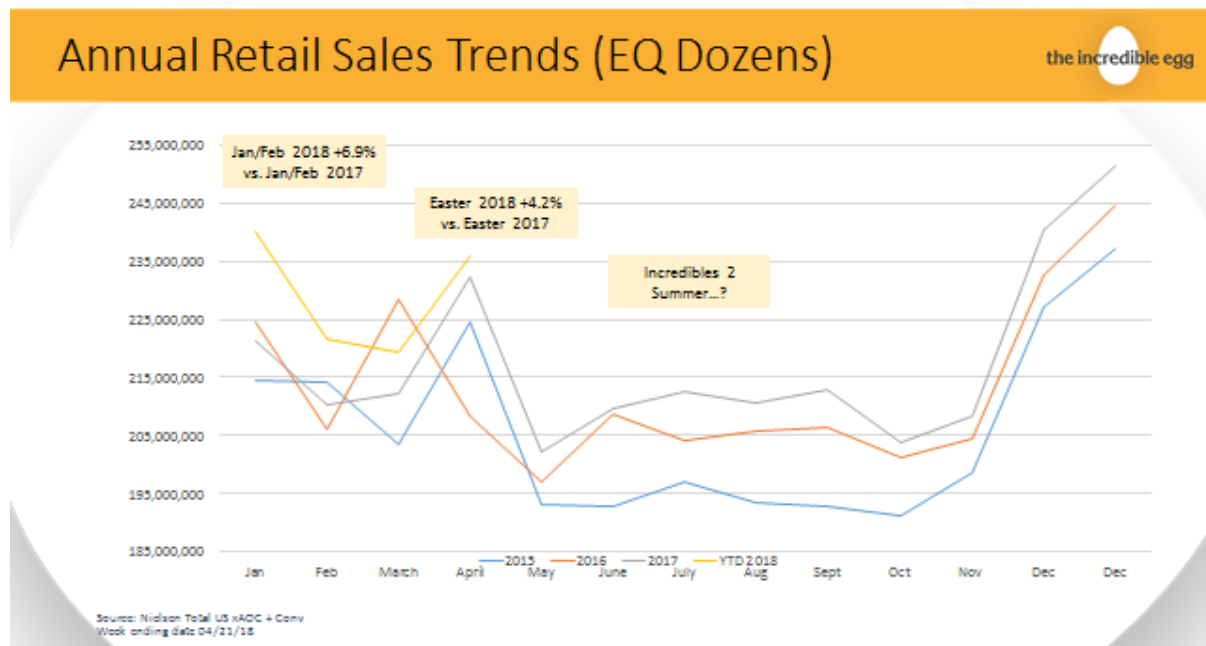


Figure 16: Bucking the trend, Source: American Egg Board June 2018

- February 2018 - American Heart Month. High impact radio media tour with Dr.Tia Rains from the Egg Nutrition Center talking about the *“heart-healthy egg as a nutritional powerhouse with high quality protein and the 9 essential amino acids with vitamins like choline, B12 and selenium”*. 18 interviews reached 46 million people.
- How do you like your eggs. (text continued on next page)



Figure 17: “How do you like your eggs” digital media campaigns, American Egg Board June 2018



Each photo shows a different character linked to themed and seasonal recipes. For example, following New Year Resolutions, a healthy start to the year could be encouraged.

### 7.1.iii. Market development

AEB also work closely with schools, colleges and universities. They identified that, with a total enrolment of 50 million children in schools, over 7 billion school meals per year are consumed for breakfast and lunch. AEB have worked hard to engage with this market, developing focus programmes with school caterers.



The slide features the 'EGGS in Schools' logo, 'the incredible egg' logo, and a table of engagement programs. On the left, there are four logos: 'EGGS in Schools', 'EGGCELLENCE in Schools', '5 DAYS 5 WAYS', and 'Eat Better. Learn Better.'.

Platform	Focus	Messaging	Tactics
Top 20	Menuing Eggs: <b>Volume</b>	Building on Your Success	Custom Program
Eggcellence	Menuing Eggs: <b>Innovation</b>	Expanding Your Success	Recognition Program/ Enter to win on-site Event
5 Days/5 Ways	Menuing Eggs: <b>Incidence</b>	Expanding Your Menu/ Fight Menu Fatigue	Culinary Program
Eat Better. Learn Better.	Menuing Eggs: <b>Nutrition</b>	Eating Eggs= Health Benefits	Integrated Education Programs

Figure 18: Engagement programmes, AEB June 2018

AEB’s “eggcellence” platform recognised 34 districts for being egg ambassadors in their school nutrition programmes in the 2017-2018 semester year. A congratulatory email, framed certificate and a logo to use on menus, social media and newsletters was provided.

Foodservice sales of eggs in schools have risen by 15.9% in 2017-2018 and an increase of 20.1% in the previous year. AEB feels the potential to increase sales in this area is considerable as the reach is currently only 1%.

AEB is also working with NACUFS (The National Association of College and University Food Services) representing leaders such as Harvard, Yale and Ohio State universities to feature eggs in ways that turn students into lifetime consumers through regular training for chefs, dedicated website, information on nutritional benefits and on-campus promotions.



Egg products are another area of importance for AEB and hold regular manufacturer workshops for food service companies including Pepsico, Tyson, Nestle and KraftHeinz. Information is provided on food safety for liquid egg, e.g. no salmonella outbreak in pasteurised egg since the Egg Products Inspection Act, 1970. Advice for caterers is provided on different ways of using eggs in recipes and best practice for handling and storage including the importance of refrigeration for maintaining quality.

AEB's recent meeting with Sysco, one of the largest food distributors in the US, has resulted in eggs being their number 1 priority project to increase sales.



Figure 19: "What eggs can do for you", AEB 2018

Of all egg servings in year ending May 2017, 79% were from quick serve restaurants such as McDonalds, Starbucks and Dunkin Doughnuts. Midscale dining (sit-in dining with waiting staff) accounted for 23% of egg servings in 2010, down to 16% in 2017. AEB work closely with all foodservice partners and, in terms of total breakfast servings in this sector, eggs were amongst the highest growing with a 3% increase in the year ending March 2018.

AEB also attend many of the major food events globally including the Gulfood Show in Dubai, the largest food event in the world attracting 100,000 visitors. Last year they featured in the "Taste of USA" pavilion and generated 18 story hits on local news and social media in Dubai. Exports now account for 3.5% of total egg sales in the US with egg being distributed to places including Mexico, Middle East and the Caribbean.

A message from the AEB was: "put an egg on it".





## 7.2. Egg Farmers of Canada (EFC)

EFC is a national organisation that represents Canada's 1000 egg farmers across all provinces to manage the supply of eggs, develop standards for the industry and promote eggs.

To do this EFC has an outreach programme that invests in evidence-based research and community engagement.



Figure 20: The author pictured with Rowan Gowing and Christine Anawati of EFC, Photo: Authors own

Christine, Senior Manager for Corporate and Public Affairs, explained EFC promotion would always start from the natural goodness of eggs and then focus on groups that include: weekday breakfast; multi-cultural; and health. The objective: to increase egg sales at retail by 2.5%.

After promoting that eggs contained no hormones or steroids, EFC's research indicated the sample group were eating less processed foods vs a year previously.

A study showed the biggest growth opportunity was increasing weekday egg consumption.

A target group for the EFC is women over the age of 25 who don't appear to eat eggs for breakfast during the week. This led to the development of the "Time-stressed Tina" campaign. The goal was to encourage this group of women to start eating eggs for breakfast one day a week. EFC recruited women videoing themselves preparing eggs to display on social media.



An added benefit was they found eggs were being cooked in more adventurous ways than first anticipated.

Consumer research identified several trends affecting women over the age of 25, including family size, what her kitchen looks like, and other food items she was most likely to eat. This group of young, mostly suburban and almost all working women, 30% of whom had children, had the lowest egg consumption rate. Half skipped weekday breakfast altogether and the main reasons cited were lack of time, too much work and having dishes to wash.

The concept “Weekday Eggs” with the message “The weekday egg is little prep with big payoff” could be targeted through those streams and stores she would regularly visit.

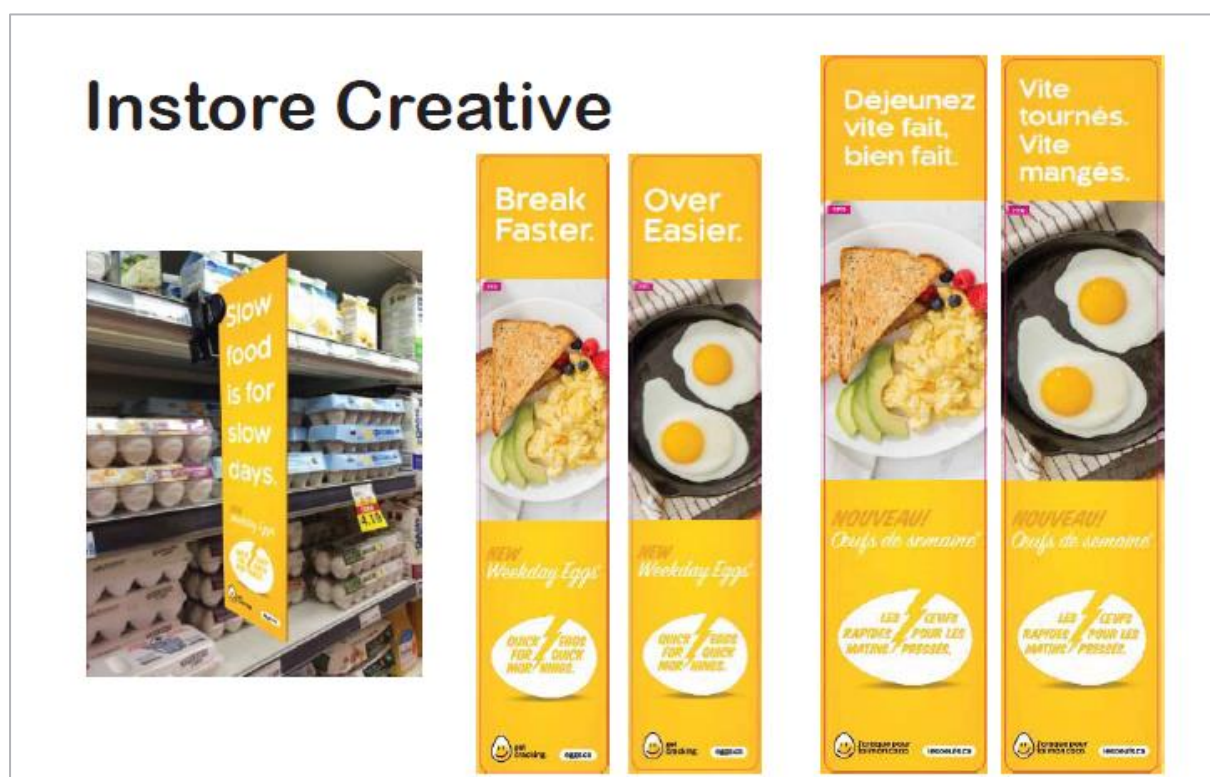


Figure 21: Weekday eggs campaign, EFC June 2018

It also included video tips on how to cook the eggs and followed up with weekday egg ads. The campaign rolled out early last year was so successful that the plan was to launch it again in the autumn. Early results of the campaign launched spring 2018 have successful ad rankings.

### 7.2.i. Downtown Diner

Downtown Diner was a street event held in Ottawa to promote the dairy and egg industries. Being a short walk from parliament, it attracted politicians including Prime Minister Justin Trudeau. (See photo overleaf)

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Figure 22: Downtown Diner. Photo: Authors own

It was also an opportunity for farmers to meet with the public. “Ask me I’m a farmer” slogans on clothing made them appear open and welcoming. I saw constant interaction between farmers and members of the public that lasted several hours over the lunch period. Free food was served that used eggs and milk, helping attract workers from nearby businesses. Famous TV chef Lynn Crawford, who is a big supporter of EFC and the egg industry, was also there.



Figure 23: Prime Minister Trudeau of Canada at Downtown Diner. Photo: Author’s own



### 7.2.ii. Social media

Rowan Weerdenberg discussed the importance of social media and how to manage the content. Supported by an agency, Rowan manages posts and comments. Over time, by building ad groups, it becomes clearer which groups are most likely to cause the wrong type of publicity, so offensive or negative posts can be controlled.

When it comes to managing social media, Rowan's key points were to *"keep the content fresh"*, monitoring the negative and targeting the most relevant groups, with quick and positive responses to genuine queries.

EFC also work closely with the medical profession and recently presented findings to every physician in the country about the latest research on cholesterol in eggs. The result was the number of physicians who limited their patient's egg consumption decreased from 65% to 25%.

### 7.2.iii. Get Cracking

Get Cracking is an independent organisation funded by Egg Farmers of Ontario representing around 40% of Canada's total egg production. Promotional activity includes a website with regular updates on everything from what the hen eats to how to store eggs safely; a presence at many public events; and support for various sports activities. Get Cracking also run 'pop-up' events in the cities, offering free tastings and the theme is yellow to symbolise the yolk. This is organised through PA Agencies and requires food permits, a payment for the location and food safety certificates.

Get Cracking features around a dozen reasons for the foodservice sector to have eggs on the menu:

1. Low cost and high profit potential
2. Little fluctuation in cost
3. Easy and quick to prepare
4. Safe and dependable supply
5. Consistent quality
6. Versatile – menu item possibilities are endless
7. Nutritious – can be included in a "healthy choices" menu section
8. Popular menu choice for customers
9. Great for "take out" items, especially at breakfast
10. Easy, effective business builder to offer an egg "special feature item" daily
11. As your partner in business, Egg Farmers of Ontario has recipes, promotional ideas and materials to help boost sales of egg items

*see photo on next page*

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Figure 24: Author with Harry Pelissero of Get Cracking. Photo: Author's own

#### 7.2.iv. Eggcentric TV

EFC also has Eggcentric TV, its own TV network, which has videos for recipes, the farmers, chefs cooking eggs, and charity work. It is now being used in other countries.

#### 7.3. Fenavi, Colombia

Fenavi are the government organisation that looks after the egg industry in Colombia. They are responsible for promoting eggs and have been key to the remarkable growth in egg consumption seen in the last 10 to 15 years.

A levy is collected from egg producers which is 7.75% of the value of the chick. In 2018, this amounted to a total fund of over the equivalent of 8 Million US Dollars. This fund is split into different programmes including one involving work with schools, the medical profession, academia, authorities and marketing.

They have action lines which are: promotion of consumption; communications; business; training; and safety.

Most of the budget is spent on mass media campaigns: TV adverts, radio, other adverts and the medical profession (8%).





TV is widely accessible in Colombia where many still live below the poverty line. Current TV ads (2018) include: a man weightlifting (**eating eggs to make you stronger**); schoolboy (**eggs make you cleverer**); and student waking up (**eating eggs for more energy**). When the news airs on the popular Caracol channel, an egg ad often features between 7 and 8pm.

Similarly, Colombians have good access to radio and, as lovers of soccer, Fenavi target the big matches to air ads around and during the games.

Major campaigns have run throughout the years including:

**“Egg is not guilty”** in 2008

**“Nature is wise: world needs eggs”** 2009

**“For winning”** 2014-2015. This starred famous BMX cyclist Mariana Pajou, 2-time Olympic Gold medallist. Cycling has a big following in Colombia so Fenavi capitalise on this popularity.

2017 and 2018 campaigns focused on families, eggs being easy to cook, and health.

A major beneficial influence on consumption came from working with the Colombian Family Welfare Institute. The Institute has overall responsibility for the welfare of young children in Colombia and it is estimated there are 4,000,000 of them under 4 years of age. The Institute is directly responsible for all orphans and abandoned children. Fenavi, using evidence from journals and articles, has influenced the Institute to use more eggs in the children’s diets. Now each child of over 2 years old in the Institute’s care is consuming one egg per day.

It is believed that the Institute’s emphasis on the benefit of eggs for children has contributed to a significant increase in annual consumption of eggs per capita of the general population: from 188 eggs per capita in 2007 to 271 per capita in 2017. A remarkable achievement!

#### **7.4. Danish Egg Association**

I met with Jorgen Larsen and Mie Nielsen Blom of the Danish Egg Association (DEA) last September.

We discussed an ongoing study of overweight pregnant women which is looking at the difference between those eating eggs and those not. Early indications suggest those eating eggs go on to have children whose brains develop faster, which would be in keeping with the benefits of choline mentioned in chapter 2.3.

*“Organic is like a religion in Denmark”* and also well established – *“you are something when you buy organic”*. However, the organic market is reaching the limit in Denmark and retailers are now having to discount organic eggs in order to sell.

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A recent promotional event featured 5 Michelin-starred chefs at the Spectacular Food Festival where they used eggs in all dishes of a 5-course meal.

Re social media, Mie (Danish Egg Association) said they fight negative comments - for example with positive invites on Facebook - closely monitoring what goes into the content.

## 7.5. Chapter Summary

- The American Egg Board is targeting the consumer in different ways including by lifestyle, age and health and building and establishing new relationships in foodservice in both schools and manufacturing
- Egg Farmers of Canada are engaging with the consumer, on the street and online
- Fenavi of Colombia are promoting eggs by major TV and radio campaigns. Colombia is the country to have seen the most significant increase in egg consumption

\*\*\*\*\*

So far, this report has identified key areas that contribute new marketing ideas to achieve a consumption increase including:

- strong industry credentials for a solid marketing base
- the egg as a complete package
- ways we can promote the egg

So how can we actually sell the egg?



## 8. Selling the humble egg

Mr Akiyoshi of Akita in Japan gave me this most succinct outlook on how we can sell the egg, specifically market differentiation:

- Housing style of the hen
- Taste
- Functionality
- Usage

In the UK and indeed much of Europe, there is an emphasis on the housing system. In the UK, we currently have 4 types of hen housing:

- Colony (enriched cage)
- Barn
- Free range
- Organic

This is the primary focus for differentiation in the UK. The other 3 of Japan's differentiation points provide opportunity for further exploitation.

It was put to me by Mr Akiyoshi that taste is the most important in the list and should be linked with functionality and used as a 2-way approach.

- Santa Reyes in Colombia regularly holds tasting sessions in supermarkets as a way of demonstrating a superior taste in their eggs in comparison to competitors.
- Functionality refers to ways the egg can be presented and a great way to build an egg brand. One example I have often seen has been the promotion of health benefits and egg enrichment.

Mr Akiyoshi said "usage" can be referred to as the time of day the eggs are consumed. EFC in Canada did this with their weekday eggs campaign which was targeted at young women; and Fenavi's campaign to promote eggs as a breakfast occasion is another example.

I found many different options on how to *present* eggs.

### 8.1. Table Egg

In the UK, approximately 79% of eggs are sold as a table egg (whole egg, uncooked, in a shell) and, of our total egg consumption, 56% is sold as shell egg at retail. (*Andrew Joret, BEIC*) Retailers segregate according to the housing system and egg size. Some sell eggs from all 4 types, and others free range and organic. Egg size is mainly split into medium, large or mixed weight per each different housing system.

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### 8.1.i. Egg size

Hens produce eggs that range in size, and are classed according to the EU sizing standards as follows: below 48g (1<sup>st</sup> egg laid or pullet egg); small 48-53g; medium 53-63g; large 63-73g; and very large 73g and over. Eggs can also be sold as double yolked eggs, laid by younger hens and have more than one yolk in a single egg.

In comparison, the US and Canada have smaller targets for each size bracket:

- small 42g
- medium 49g
- large 56g
- very or extra-large 64g

Additional brackets are for peewee under 42g, and jumbo for eggs over 70g.

DQY, a large egg producer in China, splits egg size as follows: XL for processing; L for restaurants; M and S for the consumer. Akita in Japan, who sell mostly mixed weight packs, said smaller sizes were ideal for young children. Some go one step further with 2 additional sizes for each bracket.

In the UK, EU regulation determines the weight bands in which our eggs must be retailed. If we compare to other systems, we give away more weight than others and lowering weight brackets could be a good way to add value into what is such a valuable food source. Changing political climates may lead to opportunities for reviewing standards.

### 8.1.ii. Pack size

The number of eggs sold in one pack in UK retail mostly varies between 6 and 15, with half dozen and dozen sizes being the most common.

In other countries I saw additional options on pack size: *see photos on next page:*





Figure 25: 2-pack of eggs in black and gold packaging in Japan. Photo: author's own



Figure 26: 4-pack of eggs in Japan. Photo: Author's own



Figure 27: 60-egg pack in the US. Photo: author's own



Figure 28: 24-egg pack in Canada. Photo: author's own





Figure 29: 5kg box of eggs, Hanwei, China. Photo: author's own

### 8.1.iii. Branding

Eggs are often sold on volume at the lowest cost but can also be branded and sold at a higher price.

*“Branding is the promotion of a product by means of advertising and distinctive design”* ([www.transformationmarketing.com](http://www.transformationmarketing.com)). The UK has already seen great success from egg brands including “Happy Egg”, “Kitty Campbell’s” and “Laid with Love”.

This has contributed to a steady increase of egg sales in recent years. But there are many ways to build from this: promoting other aspects such as health; lifestyle; provenance; taste; environmental; or food safety credentials.

Promoting the health benefits is always a good place to start. Santa Reyes of Colombia has a healthy line of egg products. One of the brands is specifically targeted at school children: **“Super Reyecitos”**. The focus of the brand is to feed eggs to children to help strengthen the brain during school years. The eggs are enriched with additional nutrient levels of vitamin B9, selenium and omega 3 over those of a standard egg to achieve this. B9 for good oxygenation of the blood avoiding anaemia; selenium for adequate activity in the central nervous system; and dha omega 3 for helping the brain to improve capacity of learning and cognitive function. This is achieved through biofortification (enrichment) in the hen’s feed to increase the nutrient content in the egg.



Figure 30: Super Reyecitos for kids. Photo author's own

A lot of work was put into promotion including school and supermarket days.



Figure 31: Brand building, Super Reyecitos. Photo: author's own

**Bonegg** is a brand from Santa Reyes focusing on slightly different aspects of the nutrients. These are eggs with an added source of organic selenium, and also vitamins D and E, claimed

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to be ideal for skin and memory. They are marketed as eggs with antioxidant properties - courtesy of the selenium and vitamin E - helping to eliminate harmful free radicals and other peroxides. This, in turn, helps control the aging processes of the skin and the vitamin D helps to maintain calcified bones.

Santa Reyes also have a shop called Chicken Coop where they sell eggs, chicken meat from spent hens, and various breakfast items. The next step is to open their own egg restaurant.

Akita, one of the largest egg producers in Japan, have developed several additional brands. Many of those focus on health through egg enrichment achieved by adding additional minerals to the premix of the hen's diet. Their main brands are:

**Kiyola** – sold throughout Japan and targeted at those who wanted healthy rather than junk food. A TV commercial featuring a small cat symbolising a child, was promoted by a famous singer and a comedian and launched in September 2018 for 4 months: sales increased by 5% thereafter. Below are advert posters of the campaign.



Figure 32: Kiyola, one of Akita's egg brands. Photo: author's own

This brand is exclusively used for a popular dessert snack: a custard cream puff features on the packaging.

**Vita Gold** – A multi-vitamin enriched pack, contains 9 added vitamins including B1, B12, A, D, E and K and omega fatty acids, dha and epa.





Figure 33: Akita's Vitagold brand on the supermarket shelf. Photo: author's own

**Whometala** - this was launched 2 years ago as a healthy egg for a family on a budget.

**Mount Fuji** – Recently launched, this brand symbolises the health and clean environment of the mountain and a new farm was built in the area. Mount Fuji is a symbol of Japan and is featured on the egg pack.

Some UK egg packers are also enriching eggs. Rebecca Tonks, based in Cornwall, produces the **“Boost the Roost”** brand enriched with extra selenium included in the hen's diet. Recently, a change in EU law has allowed for a higher level of selenium to be present in eggs. Although there is an increased production cost and therefore higher retail price, sales are doing well.

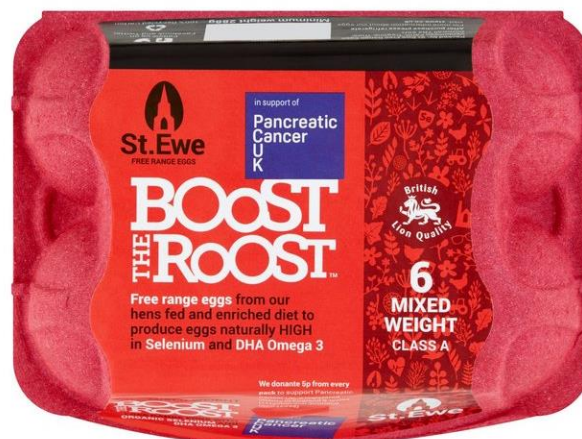


Figure 34: St Ewe's Boost the Roost eggs. [www.ocado.com](http://www.ocado.com)



Danaeg in Christiansfeld, Denmark have several brands. These include organic eggs from hens in fruit orchards; **“biodynamic eggs”** and eggs from **“privileged hens”**; seasonal egg trays; **“morning eggs”**; and **“sunny yolks”**. As a main sponsor of hospital clowns, Danaeg feature the Danish Hospital Clown logo on packaging, highlighting their collaboration with hospitals.

They also have separate lines for eggs that are exported to countries all over Europe, Asia (especially Hong Kong), and supply to the US Army as Danaeg’s eggs which satisfy increased demands for food safety.

Below, are two packs that demonstrate new and exciting scope in egg marketing. One is aimed at lifestyle choice, the other on environmental sustainability.



Figure 35: Danaeg’s fitness eggs. [www.deskgram.net](http://www.deskgram.net)

**Fitness Eggs**, a new line for Danaeg, has a specific feed for higher Omega 3 content, and distinctive pink packaging to stand out on the supermarket shelf.

Another line from Danaeg is organic eggs from hens with access to orchards. This egg benefits from hens having access to the trees which provide shelter and protection from predators and extra nutrition from fallen fruit in season. The hen also gets nutrition from insects and larvae that target the fruit. The hens help prevent damage to the fruit by eating the insects and larvae, also providing manure for trees.





Figure 36: Eggs from hens with access to fruit orchards. [www.organicdenmark.com](http://www.organicdenmark.com)

## 8.2. Food service/catering

This is a rapidly growing sector and, as consumer trends evolve, the marketplace confirms that convenience is king. (Simon Wainwright from IGD, IEC spring conference in Monaco) *“Desires for quicker meals and less cooking would lead to further growth in meal kits”*.

But if we look at some of the UK companies who specialise in this area such as Hellofresh, Gousto and Mindfulchef, eggs are not a prominent feature on the menus. On Gousto’s website for example, out of 40 dishes on “this week’s menu”, the “Speedy sausage and Egg Hash” is the only meal to include whole egg.

### 8.2.i. Eggs with other foods

In Japan and China, food-to-go is popular. Many stores have eggs regularly making up part of a meal or on their own, mostly in boiled or scrambled form. See examples below:

*see pictures on next page*

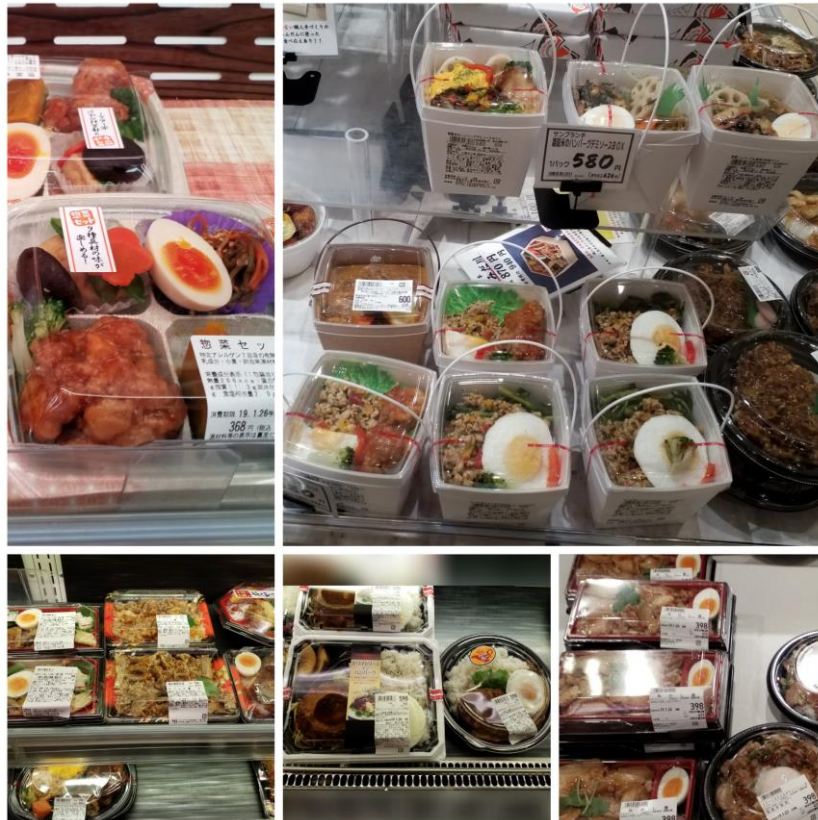


Figure 37: Pre-prepared meals with boiled eggs, Japan. Photo: author's own



Figure 38: Egg Tamagoyaki, Japan. Photo: author's own





Figure 39: Egg Salad (readymade scrambled egg), 7-Eleven store, Japan. Photo: author's own



Figure 40: Boiled egg bites. Photo: author's own



Figure 41: Instant scrambled egg, Frankfurt Airport. Photo: author's own



Figure 42: 7-Eleven (Japanese store) boiled eggs. Photo: author's own

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### 8.2.ii. Hard boiled eggs

Some UK retailers and packers currently sell hard boiled eggs. Elsewhere in the world I've seen many examples of how they can be included as part of a meal and sold on their own.



Figure 43: Soft boiled and boiled eggs with salt taste. Photo: author's own



Figure 44: Free tastings in Chinese Walmart store. Photo: author's own



Sofia and John of AEB believe that boiled eggs have significant potential in the US. 7-Eleven in Japan currently have a lunch pack retailing at 8 dollars which contains a boiled egg. Since adding a second, sales of the lunch pack have doubled.

AEB have other ideas of how boiled eggs could be used, including “Egg pops for dipping” and “Boiled egg as a bar snack”.

### 8.3. Processing

In many of the supermarkets I visited, liquid egg was a feature beside table egg displays. See examples below.



Figure 45: Various forms of liquid egg, US and Canada. Photo: author's own



### 8.3.i. Eggbase

Eggbase (part of the Kewpie Group) is one of the largest egg processors in Japan. I visited the newest facility near Tokyo and it was immaculate. Using Sanovo equipment, 2,000 eggs per minute can be processed. The egg is piped into bags as egg white, yolk, whole, or as a twin pack, then frozen. Pack sizes are now offered as low as 50g and 20g sizes (popular with care homes and airlines).

Eggbase has products like the “Fluffy Matcha Pudding” adding popular Japanese ingredients.

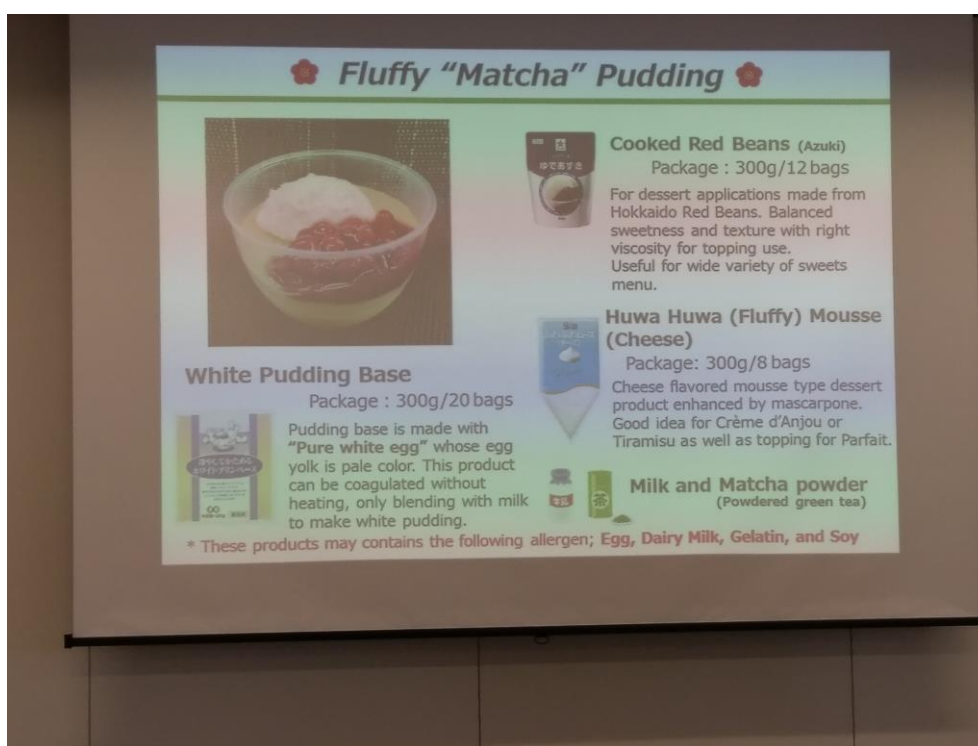


Figure 46: Fluffy Matcha Pudding. Photo: author's own

With shifts in trends and increased demand, Danaeg (Denmark) has an extensive range of liquid egg products from all housing systems including organic and Nordic barn, scrambled egg mix and “long eggs”. As well as frozen omelettes, dessert pancakes, savoury pancakes and waffles.

*see photo of “Long egg” overleaf.*





Danaeg's Pure range is powdered egg white especially suitable for those working-out, who have an increased protein requirement. It is advertised as something that can be taken anywhere, used in shakes or in meals, and quickly absorbed by the body.



Figure 47: Long egg. Photo from <https://www.danaeg.com/>

Targeting elderly people with smaller appetites, Danaeg's Care range which is made from whole egg and in powder form, contains increased amounts of protein and energy. It is available with chocolate, vanilla or neutral flavourings and is dissolved easily in water, or can be added to other foods and drinks such as porridge and milkshakes.

I visited Roseacre in the US and Hanwei in China who spoke about the advantage of having liquid and powder egg capabilities. When the price falls in the shell egg market, more egg can be broken for liquid and powder and the reverse if it rises. Hanwei see a higher demand for shell egg during Chinese New Year, a June festival and October.

*see overleaf for photo*

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Figure 48: Roseacre powder egg plant. Photo: author's own

#### 8.4. Chapter Summary

- Table egg can be sold in new ways including pack size, weight and branding. By creating market differentiation several opportunities exist with how we can brand (for example by lifestyle and age)
- Significant opportunities lie in the catering sector. Many examples exist of how eggs can be included as part of other dishes
- Improved capacity for liquid and egg processing will exploit versatility for new ways of presenting eggs



## 9. Food for thought

A fascinating and inspirational visit was meeting with Fabien de Meester in Krakow, Poland. Fabian has a PhD in Protein Chemistry and specialises in nutrition and health, and is a supporter of egg industries globally. One of his aims is to catalyse sustainable changes in the egg industry.

We discussed yolk as food for the brain as well as other fascinating opportunities for using eggs and this is the substance of what he told me:

### 9.1. Eggs beyond human consumption

- “*Egg white, the pharmacy of the future*”. The protein structures in the egg white can be used as medicines to help fight infections, by using the egg white proteins to increase the resistance of the host instead of killing the guest (like an antibiotic does). You target the animal (organism) to make it stronger and more resistant, improving immune response. Egg membrane is also being used as a dermatological and, more generally, a connective tissue treatment.
- Yolk lipids for computer chips. The same yolk lipids that feed the chick in the egg can potentially be used as data transmitters in the computer chips.
- Egg shell can be used to filter air (e-ceramics) without using energy and, in addition, is not flammable.
- Egg membrane is already being used as an ingredient for pet foods (pro-collagen) in the US and EU and as cosmetics in South East Asia although at 5Eur/kg it's currently too expensive to compete against fish sources in most markets.

### 9.2. Other opportunities

Food markets I visited in Colombia and China both had spent hens for sale with the egg follicles left inside. It's a popular food in some countries as the egg inside gives the chicken more flavour. *See photo on next page.*

Egg shell, which is rich in absorbable calcium carbonate, could be used to treat a calcium deficiency.

As a food safety improvement, if eggs had been washed, a wax coating (light and soluble) could be used as extra bio protection and could also extend the shelf life.

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Figure 49: Egg laying chicken including egg follicles. Photo: author's own

### 9.3. General discussion on increasing egg consumption

I attended the Committee on World Food Security (CFS) conference in Rome, Italy, in September 2018. Its World Food Day event theme was **“Our actions are our future”**. Sustainable and efficient food production is perhaps the biggest challenge we face as a society. World population has grown from 2.5 billion in 1950 to 7.7 billion today. (*United Nations*, [www.un.org](http://www.un.org) ).

Climate change adds significant pressure to food systems: their function and production methods must reduce the impact on the environment. This will become an increasing influence on how food industries are shaped.

The egg industry must demonstrate it can locally produce a low cost, convenient, healthy, high welfare, safe, environmentally conscious, fashionable and delicious food.

I had wanted to carry out research into egg consumption as my Nuffield Farming study tour subject because:

1. Currently it is not reaching its full potential
2. Eggs are an ideal food to help alleviate health problems in our society

What scope is there to increase consumption?

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The egg is in a strong position: a nutrient-dense low-calorie food that is competitively priced and versatile.

There is an argument to promote the egg as an efficient and sustainable food for the environment. Undoubtedly efficiencies in how we look after the hen and egg in terms of genetics, housing, feed, husbandry, and incubation continue to see significant improvements.

The number of saleable eggs is increasing as the number a hen can produce per annum, and shell strength improve. Egg grading and packing equipment is always improving.

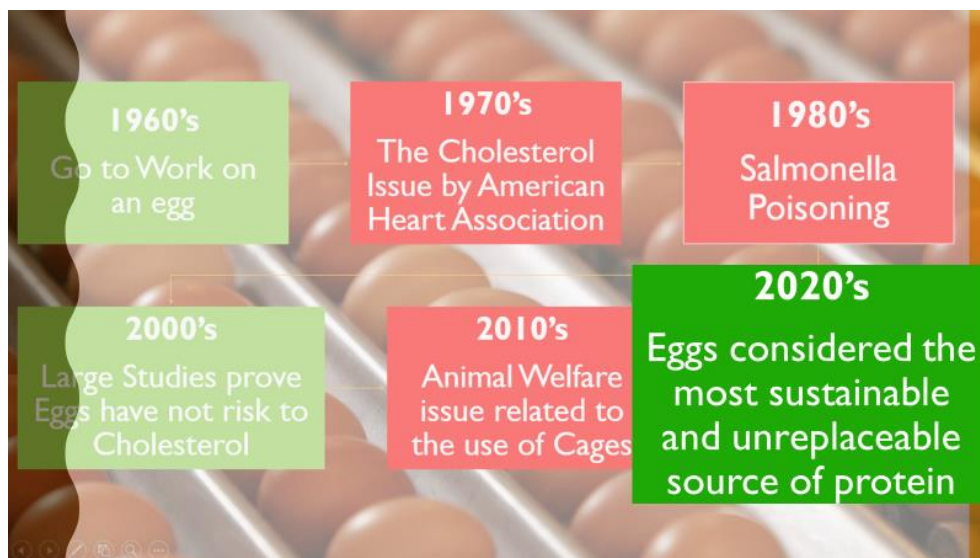


Figure 50: The future: Unreplaceable egg. Source: Carlos Savianni

So, a summary of my considered thoughts after completing my Nuffield Farming Scholarship study tour is as follows:

### 9.3.i. Food safety

We have a solid platform: the Lion code of practice has created an excellent reputation for food safety and inspires confidence for the marketing of eggs in the future.

Akita spoke about how vertical integration should be considered for better control throughout the supply chain. Whether this is the right approach for the UK egg sector or not, the word “control” really hit home for me. Support for, and working with, the farmer and stock is imperative to ensure best practice and damage limitation.



### 9.3.ii. Health benefits

- Promoting the nutritional benefits to the consumer is key. The egg provides quality protein, vitamins, minerals and antioxidant properties, all presented in a complete food. This food scores highly on the satiety index (hunger satisfaction), is low calorie and has a score of 0 on the GI (Glycaemic Index): in short, a perfect food for a balanced diet.
- The egg has demonstrable benefits for tackling obesity, cardiovascular diseases, diabetes, improving mental illness, health of the elderly and development of the young.
- The egg is attracting positive research in the health field, plus this is a tried and tested natural product.

### 9.3.iii. Consumer focus

Consider 5 consumer mega trends:

- time selective
- interpreting health
- embracing personalisation
- being more experimental
- socially conscious aspirations

*(Simon Wainwright, IEC Conference in Monaco)*

How do we cater for these social trends?

What does the public know and understand about eggs? (e.g. the health benefits). Market research is key to understanding the detail of these social trends.

Countries including the UK are seeing a shift in diet trends, with momentum moving towards plant-based foods. Canada and the USA are already aligning eggs to fit in with this trend. Could this be part of the strategy in the UK?

There are many different methods for raising awareness: e.g. working with key influencers such as celebrities, bloggers, doctors and politicians.

“Keeping the information fresh” is also important, especially with social media.

### 9.3.iv. Ways the industry can present the egg to the consumer

Instead of mainly emphasising the type of housing system the eggs were produced in, we could follow the many examples of successful branding that promote provenance, enriching eggs and health improvements.

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In China I discovered some egg businesses were selling over 25% of their eggs online. DQY makes an increasing proportion of their sales online through their own store and through Alibaba.

Target marketing to different groups (e.g. mothers, school children and elderly people) will help raise awareness.

If we leave the EU we could review egg size-bands. Currently, the demand for large eggs has increased in the UK egg market so any grade which is medium or below is worth less. Medium and small grades for school children's packed lunches could be an option.

Agroecology is an area where we can differentiate. In Denmark where organic eggs represent 30% of the total supply, some are promoting eggs that have come from organic hen houses with orchards on the range: better welfare and better for the environment.

Increasing the convenience of liquid egg and eggs for the catering industry is another area. Liquid egg increases shelf life by 3 or 4 weeks provided temperature is uniform and stable.

There is a strong demand for protein-rich foods including eggs and specifically egg white. The additional benefits of egg yolk for the mind should be noted.





## 10. Conclusions

1. Nutrient density and completeness, cost and versatility: as a food, the egg is unrivalled
2. Considerable potential for egg consumption to increase
3. Communication and promotion are vital
4. Several threats to consumption we must consider
5. Many options are available for presenting the egg
6. The ongoing improvements in genetics, welfare and an ever-reducing carbon footprint make the egg an ideal food for consumption growth

*See overleaf for Recommendations for the Industry*



## 11. Recommendations for the industry

1. Promote egg as the Nutritional Gold Mine:
  - a. highest quality protein
  - b. yolk feeds the mind
  - c. treatment and prevention of health conditions
  - d. low calorie content
2. Important egg messages: “good egg” image capitalising on the following:
  - a. “online”
  - b. “on the street”
3. Create new relationships with food service companies
4. Develop new brands in:
  - a. health
  - b. lifestyle
  - c. age
5. Invest in liquid egg and powder
6. Explore opportunities for the egg in catering



## 12. After my study tour

I have gained a tremendous amount from my Nuffield Farming Scholarship. In the past two years I've been given the opportunity to connect with the greatest minds in the egg world and to look beyond the industry I work in to learn about the wider agricultural landscape and the policy that drives it.

In the next few months I have two articles being released that will feature key details and findings from my study tour. One will be in our company newsletter which will reach 1000 farmers and businesses across the UK and Ireland. The other, will be in the November edition of the NFU Poultry magazine.

Going forward there are three key areas I'd like to focus on:

**Firstly**, I aim to continue looking at new ways of promoting the health benefits of eggs. A recent meeting with Baileys Catering Company that specialise in school meals highlighted the low demand for eggs to feature in their meal plans. I want to explore further how we can better promote eggs to companies like these, and the parents who make decisions on the meal plans.

**Secondly**, I need to hold my hands up and confess that I embarked on this study as a non-egg eater! They didn't agree with me as a child. I am delighted to say that I now eat egg yolks!

Now, I want to learn about different ways of cooking and presenting eggs and how we best tap into the modern consumer mindset to tempt them into consuming more eggs.

**Finally**, I realise that the egg industry - like most agricultural sectors - is facing significant shortages of capable young people choosing farming as a career path. Recently, through the Royal Highland Education Trust, I presented to groups of 250 school children at a careers day in Ayrshire to promote the egg industry as a solid career move. I want to continue working in this area.

**Jamie McIntosh**  
**November 2019**



## 13. Thanks and Acknowledgements

The following people and organisations have been instrumental in providing me with the knowledge and the contacts which has ultimately led to the completion of this report.

I am truly grateful to you all, thank you.

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<b>Vicki Sandilands</b>	<b>Hongwei Xin</b>	<b>Mr. Masatsugu Nakagawa</b>
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<b>Jean-Paul Michalski</b>	<b>Neil Newlands</b>	<b>Nobuhiko Nishimura</b>
<b>Veli Moluluo</b>	<b>Rowan Gowing</b>	<b>Mr Takashi Okano</b>
<b>Gary Ford</b>	<b>Stephanie Polianski</b>	<b>Miss Yurika Masatou</b>
<b>Nick Chippindale</b>	<b>Judi Bundrock</b>	<b>Mr Yusuke Uchiyama</b>
<b>Sir John Campbell</b>	<b>Harry Pelissero</b>	<b>Pete Block</b>
<b>Claire Bragg</b>	<b>Fabien De Meester</b>	<b>Math Lemmers</b>
<b>Matt Swain</b>	<b>Jorgen Larsen</b>	<b>Pieter-Jan Luykx</b>
<b>Nuffield Poultry Group</b>	<b>Anina Kjaer</b>	<b>Carlos Lozano</b>
<b>Geraint Powell</b>	<b>Mie Blom</b>	<b>Mr Yamamoto</b>
<b>Andres Valencia</b>	<b>Mette Andersen</b>	<b>Mr Watanabe</b>
<b>Juan Pablo Mendez</b>	<b>Christian Nielsen</b>	<b>Mr Shimizu</b>
<b>Josh Tetrick</b>	<b>Rudi Preisinger</b>	<b>Mr Goto</b>
<b>Karen Rust</b>	<b>Wayne Dredge</b>	
<b>Mike Clayton</b>	<b>James Han</b>	



## 14. Appendices

There are 5 Appendices to this report:

1. British Eggs: Back on the menu for all – Gray – 2018
2. Unreplaceable egg
3. EAT Lancet Report
4. Breakfast foods, Euro Journal Clinical Nutrition, 1995
5. The glycaemic index revisited

Please see subsequent pages



## 15. Appendix 1: British eggs: Back on the menu for all

**This is taken from a paper by Dr J. Gray**

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- Abstract
- Introduction
- British Lion eggs pronounced safe

### Abstract

This article updates the latest guidance and research on the suitability of eggs as a good source of nutrition for particular population groups. This follows the publication of two important UK government reports: revised advice for vulnerable groups from the Food Standards Agency and a draft report about infant feeding from the Scientific Advisory Committee on Nutrition (SACN), as well as a recent review on egg consumption and cardiovascular disease risk in people with type 2 diabetes. The Food Standards Agency now advises that raw or lightly cooked British eggs are safe to eat for vulnerable groups, such as pregnant women, babies, toddlers and older people, provided that the eggs bear the Lion mark. This indicates that they have been produced under the British Lion Code of Practice, a scheme that includes more than 700 auditable criteria, of which vaccination of laying hens against *Salmonella* is a key aspect. The draft SACN report *Feeding in the First Year of Life* recommends that first complementary foods should be introduced from around 6 months of age and that there is no need to differentiate hen's egg from other foods in this respect. There is also a warning that the deliberate exclusion or delayed introduction of allergenic foods including egg may increase the risk of allergy to these foods later in childhood. As regards people with type 2 diabetes, despite earlier concerns from epidemiological studies that higher egg intake might increase cardiovascular disease risk, more recent high-quality intervention studies indicate that, provided eggs are consumed as part of a healthy, energy-controlled diet, there is no need for concern. Eggs provide a wide range of important nutrients, including several that are found in only a limited number of other foods, such as vitamin D, iodine and the long-chain omega-3 fatty acid, docosahexaenoic acid. They are therefore a useful and versatile ingredient for pregnant women, infants and children, and older people.

### Introduction

2017 was a good year for eggs with the publication of several positive reports, which should be particularly welcome news for those caring for babies, toddlers and older people. Almost 30 years after eggs were taken off the menu because of concerns about *Salmonella*, the much anticipated

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revised guidance from the Food Standards Agency (FSA) was published in October last year (FSA 2017). This finally gave the stamp of approval for soft-cooked or ‘runny’ British Lion eggs, meaning that they are now officially back on the menu for babies, toddlers, pregnant women and older people – all potentially vulnerable groups who previously were advised to avoid soft-cooked eggs because of the risk of *Salmonella* food poisoning. Also of particular relevance for parents and carers of young babies was the draft report from the Scientific Advisory Committee on Nutrition (SACN 2017) – *Feeding in the First Year of Life*. This draft report, which was discussed in detail in an Editorial in the December edition of *Nutrition Bulletin* (Chambers 2017), considered the association between nutrition in the first year of life and health risks later in childhood and beyond. An important aspect of the draft report was the review of the timing of introduction of complementary feeding (weaning), including the introduction of allergenic foods, such as eggs. The SACN draft recommendations re-emphasised the existing and often overlooked or poorly understood advice from the Department of Health (DH) that eggs and other allergenic foods can be introduced one at a time from around 6 months of age – the recommended age of introduction of first solid foods – alongside continued breastfeeding. A period of public consultation followed publication of the draft report and the final report and implementation of SACN recommendations by Public Health England are awaited later this year. Concerns have also been raised about egg intake in another vulnerable group, people with type 2 diabetes (T2D), because of observational data suggesting that higher egg intake in this group might increase cardiovascular disease (CVD) risk. However, as discussed in an Editorial in *Nutrition Bulletin* last year and in a recent review from Denmark, there is now mounting evidence to suggest this is not the case (Fuller *et al.* 2017; Geiker *et al.* 2017).

## British Lion eggs pronounced safe

The change in advice concerning British Lion eggs follows the publication in January 2016 of the findings of an expert group established by the Advisory Committee on the Microbiological Safety of Food (ACMSF), as discussed in *Nutrition Bulletin* last year (Gray 2016), and later updated (ACMSF 2016). This report demonstrated that there had been a dramatic reduction in the presence of *Salmonella* bacteria in UK shell eggs produced under the British Lion Code of Practice (BEIC 2013), which now accounts for more than 90% of eggs produced in the UK (BEIS 2017). Concerns about *Salmonella* in eggs first arose in 1988 when rates of salmonellosis arising from eggs were shown to be high, and a new strain of the bacterium – *Salmonella* enteritidis phage type 4 (SE PT4) – was later observed within the body of the egg, unlike conventional *Salmonella* strains which had previously been shown to contaminate only the shell (Humphrey *et al.* 1989). As a result, DH introduced the advice for all vulnerable groups to avoid raw or lightly cooked eggs.

Subsequently, the UK egg industry introduced a number of measures, culminating in the introduction of the British Lion Code of Practice in 1998 (BEIS 2017), which has led to the decline in *Salmonella* infection associated with UK eggs. Whilst vaccination of laying flocks against *Salmonella* enteritidis and *Salmonella* typhimurium is a key element of the scheme, the Lion Code of Practice includes more than 700 auditable criteria, setting stringent controls throughout the production chain and including strict hygiene controls, regular egg testing and individual egg stamping with the best before date and Lion logo. It is the only UK egg-specific assurance scheme that meets the exacting ISO 17 065 international accreditation standard (ISO 2012).



FSA revised its advice on the basis of evidence showing that the risk of contracting *Salmonella* from UK-produced eggs was extremely low (ACMSF 2016), meaning that groups vulnerable to infection (infants, young children, pregnant women and older people) and who would be more likely to suffer serious effects of such infections, could now eat raw or lightly cooked eggs. However, it is important to recognise that this new advice only pertains to UK eggs produced under the British Lion scheme. The advice for all vulnerable groups on non-Lion UK eggs, eggs produced outside the UK and eggs from other species, such as ducks, remains the same: they should be cooked until hard. It is also important to note that the revised advice on Lion eggs does not apply to individuals who are severely immunocompromised, who should continue to follow the advice of their medical advisors on appropriate dietary intake.

### **Conflict of interest**

The author received no direct financial contribution towards the production of this article. However, Dr Juliet Gray is an independent advisor to the British Egg Industry Council on scientific issues.



## 16. Appendix 2: Unreplaceable egg: is there a substitute?

By Carlos M. Saviani

### GLOBAL SUSTAINABILITY LEAD

Published on April 9, 2019

I was recently invited by the International Egg Commission ([IEC](#)) to speak at their annual conference, the largest global event of the egg industry, the [IEC Business Conference Monte Carlo 2019](#). And I was challenged to cover the topic **Unreplaceable egg: there is no substitute**. I definitely got flattered and humbled by the invitation, especially because it happened after I had told them about my decision to leave WWF and that I wouldn't be with the organization any more by the time of the conference at April 9. They said they were inviting me as a professional and as a leader in food sustainability, nothing else. At the same time, I was puzzled by the topic, so I set on a journey first to understand why it would be important for the egg industry at this moment and second, could I stand behind it and talk about it?



I started my research by focusing first on what external stakeholders to the egg industry are saying about eggs. It was impossible not to stumble on a growing movement, at least in the western world, against animal proteins in general, not only connected to animal welfare and ethical reasons anymore, but also linking them to the destruction of the planet, to environmental issues. The most graphic case I could find that exemplify well this movement was the [“Million Dollar Vegan: Fight Climate Change with Diet Change”](#) campaign, founded by Matthew Glover, story by 12 year old activist and TEDx speaker Genesis Butler and supported by over 600 thousand people on Change.org and several athletes, celebrities, musicians and millionaires like Paul McCartney, Joaquin Phoenix, Kate Mara, Lewis Hamilton, Jane Goodall, Woody Harrelson, Mena Suvari and Moby, just to mention a few. They initiated this long-term campaign by challenging people to go vegan for Lent, starting with the Pope: **“For the sake of animals, all people, our future, and this planet, we are calling on Pope Francis to demonstrate leadership on these issues by trying vegan for Lent”**. And they offered the Pope \$1 million dollars in donation to any institution of his wish if he accepted the challenge.

I also learned that the modern Egg Industry is already familiar with this match between Good and Evil, that more recently has become more and more polarized like almost any topic nowadays (would it be because of social media?). In the last six decades they went through at least 5 big shifts from one side to another that had big impacts on the image and on the consumption of eggs: 1st - the “Go to Work on an Egg” phase in the 1960's starting in UK that marked the growth in the use of eggs around the world for breakfast. 2nd - The Cholesterol Issue brought by the American Heart Association in the 1970's wrongly concluding that eggs had a negative impact on people's health (later it was found that carbs have the worst impacts). 3rd - Salmonella Poisoning cases in the 1980's that had a huge negative impact on the perception of eggs. 4th - In the early 2000's, a series of Large Studies proved that Eggs have not risk to Cholesterol if consumed by no more than 3 eggs a day. Egg consumption gradually regains a steady path of consumption growth. 5th - Animal Activist Campaigns against eggs because of the use of cages in the late 2000's and through 2010's put a lot of pressure on the egg industry. The

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issue is still unfolding especially in the US and in the developing world. So, what's next? Would the egg industry be facing another negative phase where the eggs will be now villainized because of their environmental impacts?

Depending on the [EAT Lancet Commission](#) and their recent report the answer is YES. Eating less, much less eggs and other animal proteins could help us avoid environmental catastrophe, according to this report. For this international commission of 37 scientists, the way we eat and produce food has become so destructive to the environment and our health that it now threatens the long-term survival of the human species. We now have so many interconnected food-related crises — climate change, pollution, and food waste, not to mention malnutrition and obesity — that it will be impossible to feed the 10 billion people expected by 2050 unless we make dramatic changes to our diets and farming practices, the researchers argue. The report acknowledges that animal agriculture can be beneficial to ecosystems in some contexts. But “plant-based foods cause fewer adverse environmental effects” than animal products by every metric. Feeding everyone within planetary boundaries will also mean changing agricultural practices and reducing food loss. *“But we estimated that changes in food production practices could reduce agricultural greenhouse gas emissions in 2050 by only 10 percent, whereas increased consumption of plant-based diets could reduce emissions by 80 percent,”* it says. So, we could help limit the climate and pollution mess by scaling back meat, eggs and dairy and scaling up grains, legumes, and nuts. The researchers also call for a global treaty to limit the political influence of the food industry — modeled on the WHO’s Framework Convention on Tobacco Control.

What’s needed, according to the report, titled “[Food in the Anthropocene: The EAT-Lancet Commission on healthy diets from sustainable food systems](#),” is a new philosophy for how to eat on planet Earth. They call for a 50 percent reduction in global consumption of red meat and sugar, and an over-100 percent increase in nuts, fruits, vegetables, and legumes, by 2050. **Eggs are practically non-existent in the diet.** It recommends no more than a half an ounce per day, or fewer than two eggs total in a week.

Many are calling it a virtuous rebrand of the Mediterranean diet—a characterization they might agree with. The study’s lead author has been accused of pushing outdated nutritional science—in particular, recommending a diet low in saturated fats, which the report calls for in the form of less beef, eggs, and dairy. That’s pissed off the animal agriculture industry, and dietitians and paleo freaks aren’t having it either. Others have accused the authors of misunderstanding available resources for agriculture and sustainable food production, and called the funders out-of-touch, hypocritical Norwegian billionaires (by the way, the funding for the initiative came from the [Wellcome Trust](#) in the UK and the [EAT Foundation](#), the private foundation of Norwegian billionaires Gunhild and Petter Stordalen).

So it’s no shocker that there’s been some pushback to the report, and not just from the [usual suspects](#) in [the meat industry](#), who seem to feel increasingly threatened by modest increases in [flexitarianism](#), veganism, and good old-fashioned vegetarianism. A few researchers, politicians and doctors have also quibbled with some of the details in the dietary advice, and whether we really know what a healthy diet for all humans looks like. Let’s take a look of what some of them said.

According to Stanford meta-researcher [John Loannidis](#), nutrition science hasn’t yet been able to prove if there is a single set of nutritional guidelines as specific as the ones in the **Lancet** report for all humans

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to follow. The problem, he says, is that the nutrition studies provided by the researchers to back up this “healthy” diet are observational, which means they can’t actually tell us whether one thing **caused** another thing to happen — only that two things are associated. *“Much has never been tested in randomized trials and they continue to promote it as if it is solid knowledge”*, he told [Vox](#).

He went on to explain that the only component of the EAT-Lancet diet that has been evaluated with large randomized trials is unsaturated versus saturated fats: “There is indeed a small/modest observed benefit for cardiovascular events but even this seems to be driven mostly by the trials that are not adequately controlled. Sugars and added sugars have been assessed in small randomized trials with mostly unimpressive results.”

In a [piece](#) for Psychology Today, [Georgia Ede](#), a psychiatrist and nutrition consultant, writes that *“animal foods are essential to optimal human health”* and describes the various ways she thinks the EAT-Lancet Commission authors fail to provide adequate scientific evidence for the nutritional value of a plant-based diet. *“For those of us with insulin resistance (aka ‘pre-diabetes’) whose insulin levels tend to run too high, the Commission’s high-carbohydrate diet — based on up to 60 percent of calories from whole grains, **in addition to** fruits and starchy vegetables — is potentially dangerous,”* Ede notes.

What about all the people who are malnourished or don’t eat much animal proteins at all? As shown by [World Resources Institute](#), animal products’ consumption varies greatly by country. And even the EAT Lancet report notes that many of the 1 billion of the world’s population who are malnourished need more animal products in their diet, not less. *“In some places, like rural sub-Saharan Africa, and rural South Asia, people don’t get enough animal products to get their growth cognitive needs,”* said [Jessica Fanzo](#), associate professor at Johns Hopkins and a Lancet co-author. Stunting in kids, for instance, is sometimes associated with low consumption of animal products and other protein-rich foods.

In fact the report generated reactions in the developing world too. For [Gebregziabher Gebreyohannes](#), Ethiopia Ministry of Agriculture, the report is certainly a step in the right direction, but it is not as global in its outlook as it could be. For example, he notes the potential of eggs to reduce stunting and asserts that many Africans, might benefit from more *“animal source protein.”* *“It could say more about how, in the developing world, milk, meat and eggs are necessary ingredients in the sustainable, healthy diets that we all strive for, and that they support the livelihoods of millions, across Africa and Asia.”*

[Shenggen Fan](#), Director General for the International Food Policy Research Institute, was born in a poor village in Jiangsu province, China, where they were hungry all the time and lacked basic things — electricity, roads and food. *“The Chinese think that part of the reason why they are shorter than other nationalities is a lack of access to milk and eggs. If you drink a cup of milk a day, or have an egg a day, you will get taller. There is good evidence that animal-source foods reduce stunting. When I grew up I never, ever had them. I only saw fresh milk for instance when I went to college.”*

Nobody disagrees that Animal Proteins, in average, tend to have higher environmental impacts than Vegetable Proteins. *“What concerns me the most is that, while livestock has an impact, the report makes it sound as if it was the leading source of the impacts. By far the use of fossil fuels are the leading source of carbon emissions”*, said [Frank M. Mitloehner](#), a renowned professor and researcher at UC Davis in Livestock Life Cycle Analyses (technique to assess environmental impacts associated with all *Explore new ways eggs can be marketed to maintain a steady increase in egg consumption* ... by Jamie McIntosh.

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the stages of a product's life). He also disagrees with the method used by the council to determine the amount of greenhouse gases produced by livestock and believes that their conclusions are mostly driven by the human health assumptions they selected rather than by environmental impacts.

For [Jason Clay](#), Sr. Vice President of Markets for WWF, *“Switching from animal proteins to other proteins is not a panacea — for people or nature. Not all proteins are equal—equally nutritious or impactful. All food production has impacts. We need to avoid top-down assumptions about shifting between food groups, particularly when calculating global need”*. He goes on to say that proteins like seafood, tree nuts, milk and soy or other pulses all come with potential negative environmental impacts. *“Almonds, and all tree nuts, take enormous amounts of water and will be hard to adapt to shifting weather conditions. Soy and pulses are the second largest driver of deforestation and grassland conversion globally.”*

Aligned with Jason’s remarks are the results of a [study published on Nature](#) in 2017 comparing the environmental impact of omnivorous, ovo-lacto-vegetarian, and vegan diets. It was the first-time environmental impacts of three dietary regimens were evaluated using individual real and recorded dietary intakes rather than hypothetical diet or diets averaged over a population like the EAT Lancet report did. The omnivorous choice in fact generated worse carbon, water and ecological footprints than other diets but not by a huge difference. No differences were found for the environmental impacts of ovo-lacto-vegetarians and vegans, which also had diets more adherent to the Mediterranean pattern. A high inter-individual variability was observed through principal component analysis, showing that some vegetarians and vegans have higher environmental impacts than those of some omnivores.

Paper and power points can hypothetically accept anything, but are the conclusions and recommendations of the EAT Lancet report even practical? That’s exactly the question [Sam Bloch](#), a trending young journalist who has been writing about food, arts and culture for many publications including The New York Times and L.A. Weekly, had in mind when [he decided to follow the diet for a week](#). His conclusions: *“To follow the diet, eaters have to forgo packaged foods in nearly every aisle of the supermarket and any food from restaurants and there’s not a chance that would happen in America, where only 15 percent of people say they love to cook.”* He concluded that it’s almost impossible to define what exactly those foods or dishes have and by how much. *“All the ingredients you typically see in processed foods, like partially hydrogenated oils, refined grains, and various salts and preservatives, according to the report, are environmentally unsustainable. A diet free of additives and preservatives also makes it practically impossible to switch to substitutes or alternatives that are theoretically good for the planet, because their formulations can be too complicated.”*

That was the case with an egg replacement Sam found in the grocery store, a legume-based egg substitute extolled as good for the planet. *“For a moment, browsing the aisles of the grocery, I thought about buying it. But what about the 16 ingredients in the product? The label said the product “contains less than 2% of” various additives and preservatives. If I was keeping track of how much of each food group I was consuming, I’d assume the rest was water, legumes, and canola oil. But there’s no way to break that down into constituent parts, to know just how many legumes I would be eating in a single serving of “protein isolate.” The exact formulation is proprietary. Yet here, too, the plant-based options have an Achilles heel. Their heavily processed, lengthy ingredient list is out-of-step with consumer demand for whole, natural products.”*

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He also observed that soy protein is often the favored ingredient for plant-based manufacturers attempting to mimic the texture of animal proteins. However, the extrusion process through which the protein is separated from oil involves heavy processing with industrial chemicals. The final products are also very often high in salt, added sugars, and flavoring in order to make them palatable. When you consider that 69 percent of consumers prefer their food to be free from artificial ingredients, plant-based foods have a clear weakness. For him, the EAT Lancet diet not only is impractical but it's also more expensive: *"To feed two people for a week, I spent \$259.54 on groceries. That's on the higher end of the cost spectrum. The USDA-recommended "moderate" grocery plan for a two-person household is \$141.30 a week, according to recent figures."*

It's true indeed that most dietary guidelines around the world do recommend a higher consumption of plant-based foods in relation to animal-based foods, on average 2/3 versus 1/3, which is much more balanced than what the EAT Lancet report commends. It's also true that in developed countries the total consumption of proteins, in particular the average consumption of animal proteins, is much higher than what's recommended both in absolute terms and in proportion to the amount of vegetable proteins. In the developing world is quite the opposite, with most of Asia, Africa and some Latin America countries not consuming enough animal proteins per capita, as already mentioned above.

There are a series of market researches showing that the population in developed countries is becoming aware of that reality, and some have already been trying to increase the amount of vegetables in their diets. A 2017 research done by Nielsen in US for example showed that 39% of Americans are actively trying to incorporate more plant-based foods in their diets. In another research done by Ipsos at the end of 2017, 54% of adult Americans said that they are trying to consume fewer animal-based foods (meats, dairy and eggs) and more plant-based foods (fruits, grains, beans and vegetables). In fact the sales data on plant based foods are confirming that trend.

*Author's Note: the rest of this document can be seen on the author, Carlos Saviani's, LinkedIn page*



## 17. Appendix 3: EAT-Lancet Report

The EAT-Lancet Commission on Food, Planet, Health brought together 37 world-leading scientists from across the globe to answer this question:

**Can we feed a future population of 10 billion people a healthy diet within planetary boundaries?**

The answer is yes, but it will be impossible without transforming eating habits, improving food production and reducing food waste.

The EAT-Lancet report is the first full scientific review of what constitutes a healthy diet from a sustainable food system, and which actions can support and speed up food system transformation.

It can be read in detail here: <https://eatforum.org/eat-lancet-commission/>



## 18. Appendix 4: Satiety List

The Satiety Index was developed in the mid '90s from a study at Sydney University in Australia. The goal was to explain which foods keep you feeling full longer. While it doesn't take nutritional value or calorie content into account, it does serve as a reference for people trying to eat things that will help them stave off hunger longer. (<http://bcbstwelltuned.com/2018/02/08/satiety-index-foods-satisfying/>)

The index starts with a slice of white bread as its base, which is assigned a value of 100%. All other foods are rated relative to the bread.

Foods that keep hunger at bay longest score high, and foods that leave people feeling hungry soon after eating score low.

<b>Bakery Products</b> Croissant 47% Cake 65% Doughnuts 68% Cookies 120% Crackers 127% <b>Snacks and Confectionery</b> Mars candy bar 70% Peanuts 84% Yogurt 88% Crisps 91% Ice cream 96% Jellybeans 118% Popcorn 154% All-Bran 151% Porridge/Oatmeal 209% <b>Breakfast Cereals with Milk</b> Muesli 100% Sustain 112% Special K 116% Cornflakes 118% Honeysmacks 132%	<b>Carbohydrate-Rich Foods</b> White bread 100% French fries 116% White pasta 119% Brown Rice 132% White rice 138% Grain bread 154% Whole meal bread 157% Brown pasta 188% Potatoes, boiled 323% <b>Protein-Rich Foods</b> Lentils 133% Cheese 146% Eggs 150% Baked beans 168% Beef 176% Ling fish 225% <b>Fruits</b> Bananas 118% Grapes 162% Apples 197% Oranges 202%	Baked beans 168% Grapes 162% Whole meal bread 157% Grain bread 154% Popcorn 154% Eggs 150% Cheese 146% White rice 138% Lentils 133% Brown Rice 132% Honeysnacks 132% All-Bran 151% Crackers 127% Cookies 120% White pasta 119% Bananas 118% Jellybeans 118% Cornflakes 118% Special K 116% French fries 116% Sustain 112% White bread 100% Muesli 100% Ice cream 96% Crisps 91% Yogurt 88% Peanuts 84% Mars candy bar 70% Doughnuts 68% Cake 65% Croissant 47%
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Table adapted from S.H.A. Holt, "A Satiety Index of Common Foods," European Journal of Clinical Nutrition, September 1995, pages 675-690.  
J.C. Brand Miller, P. Petocz,  
and E. Farmakalidis,

**See over page for the list showing the most filling food at the top**

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### The list with the most filling food at the top

Potatoes, boiled	323%
Ling fish	225%
Porridge/Oatmeal	209%
Oranges	202%
Apples	197%
Brown pasta	188%
Beef	176%
Baked beans	168%
Grapes	162%
Whole meal bread	157%
Grain bread	154%
Popcorn	154%
Eggs	150%
Cheese	146%
White rice	138%
Lentils	133%
Brown Rice	132%
Honeysnacks	132%
All-Bran	151%
Crackers	127%
Cookies	120%
White pasta	119%
Bananas	118%
Jellybeans	118%
Cornflakes	118%
Special K	116%
French fries	116%
Sustain	112%
White bread	100%
Muesli	100%
Ice cream	96%
Crisps	91%
Yogurt	88%
Peanuts	84%
Mars candy bar	70%
Doughnuts	68%
Cake	65%
Croissant	47%



## 19. Appendix 5: The glycaemic index revisited

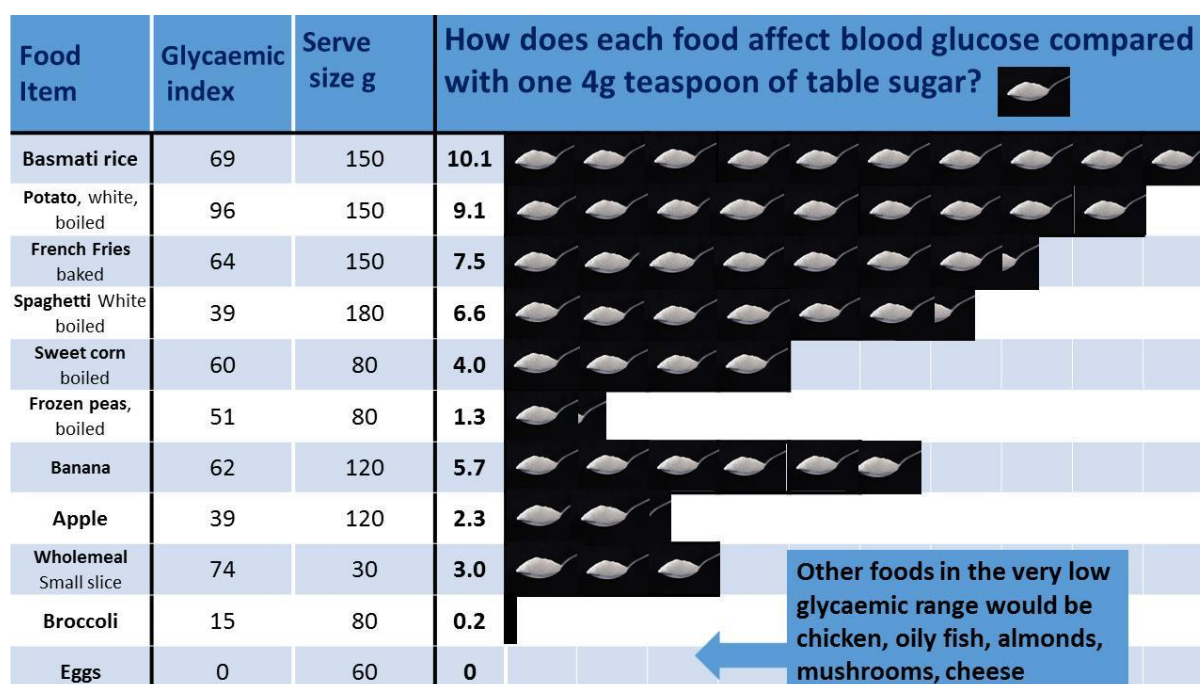


Figure 51: The glycaemic index revisited, D J Unwin et al







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