Spring 5-13-2018

Animal Agriculture and American Health: the Search for Sustainable Protein

Britta Brinkmann
Augustana College, Rock Island Illinois

Animal Agriculture and American Health:

the search for sustainable protein

Britta Brinkmann, Augustana College

2 February 2018

Background

Environment

An estimated 14.5% of global greenhouse gas emissions are emitted by the animal agriculture industry each year, which is comparable to the emissions from the global transportation sector annually (Gerber et al. 2013). Many diverse organizations are conducting studies and reviews to determine how to run the animal agriculture business most efficiently (Committee et al. 2015). EPA regulations to this industry are startlingly lax (Agriculture 2017), and until the collected evidence is convincing enough to sway congress, regulations will continue to be lax. In an opinionated exposé, Runge (2007) explained how big agribusiness is able to produce tons of methane and CO_2 each day without significant oversight. This journal piece compared the agriculture industry to the tobacco industry, and predicted that it will take large swaths of people becoming sick to alert the average citizen that something is wrong with the industry (Runge 2007). An effective way to improve human health and the environment is to link the two motivators (Institute... 2001), giving humans multiple motivations to achieve the same objective.

Meat, eggs, and dairy products have been an important source of protein in the U.S. for centuries (Daniel et al. 2011). In the past century, the United States has shifted from a primarily rural and agricultural society to an urbanized large-scale-production society (Adams 2006). The majority of U.S. citizens continue to follow diet trends set by their ancestors, despite health-risks (Daniel at al. 2011), although the attitude towards plant-based eating is shifting (Leiserowitz et al. 2017). Scientific magazines continue to publish information on pursuing a more eco-friendly diet. Anthropocene recently published “Dietary Recommendations for a Warming Planet” (Bryce 2017), recommending high intake of vegetables, fruits, and nuts in order to decrease our consumption of animal products. Bryce (2017) found that, by large numbers of citizens switching to a plant based diet, greenhouse gas emissions would drop 13-24%, land use would decline by 17%, and eutrophication would decrease by 21%.

More than half of arable land worldwide is used for the livestock industry in some capacity (Westhoek et al. 2011). The land is used for grazing, feed production, or waste disposal. The demand for grass feed far exceeds natural grasslands (Hererro et al. 2013). Planting grasslands and crops for livestock feed is the leading cause of deforestation (Hererro et al. 2013), and also uses much more water per acre than a typical natural grassland. One third of the world's freshwater goes to the livestock sector, whether to water the livestock directly or to grow their feed (Hererro et al 2013). More freshwater is polluted by improper manure disposal (Hererro et al. 2013). Beef and dairy account for 70% of emissions from the livestock industry; ruminants (including cattle) release high amounts of methane as part of their digestion process (Westhoek et al. 2011). In addition to these statistics, the demand for animal products will only increase as global population increases. Cutting out beef and replacing it with poultry will still have high emission levels, but would lower the estimation for 2050 by around 10% (Pelletier & Tyedmers 2010).

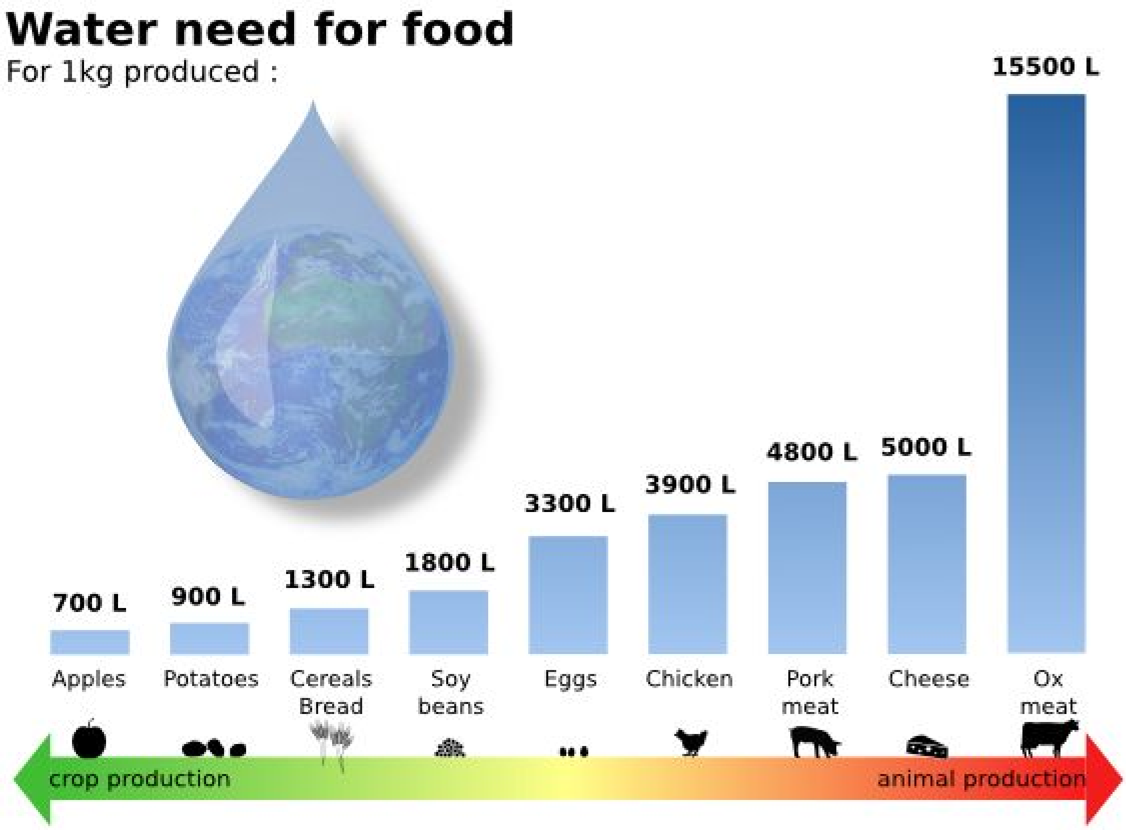

Figure 1. This chart demonstrates liters of water needed to produce 1 kg of food. Animal products use more water per kg of food produced. Ruminants (cattle) especially use water inefficiently. Source: Thompson 2017.

Fisheries are also overburdened with production (Westhoek et al. 2011). At least half of global fish populations are fully exploited (fully fished to maximum capacity- any more fishing could lead down a path to extinction) and another quarter of the global fish populations are at least overfished (Westhoek et al. 2011). Humans are reaching the edge of fishable oceans (Jaquet 2017), which has motivated the rise in farmed fish. Farmed fish are also inefficient because smaller fish are caught, transported, and fed to larger fish (Jaquet 2017). Fish may also understand pain and suffering, which diminishes the argument that eating fish is more ethical than beef or pork or chicken based on the intelligence of the animal (Braithwaite 2010).

The animal agriculture business is responsible for disease, poor nutrition, a rise in emissions, the removal of forest, and overuse of freshwater on earth, yet the industry is a global economy and provides food security and jobs to billions worldwide (Hererro et al. 2013). Any change to this system could hurt the livelihood of hundreds of thousands of American citizens (Hererro et al. 2013).

Diet

The standard American diet is nutritionally inadequate. Three out of four Americans don't eat a single piece of fruit in a given day, and nine out of ten do not reach their needed vegetable intake (NutritionFacts.org). Only 11% of the standard American diet comes from whole, healthy plant foods (NutritionFacts.org). The standard American diet is rich in meat and animal products, which have links to diabetes and heart disease (Satija et al. 2017). NutritionFacts.org recommends eating more fruits, vegetables, whole grains, and reducing meat intake to support a healthy lifestyle.

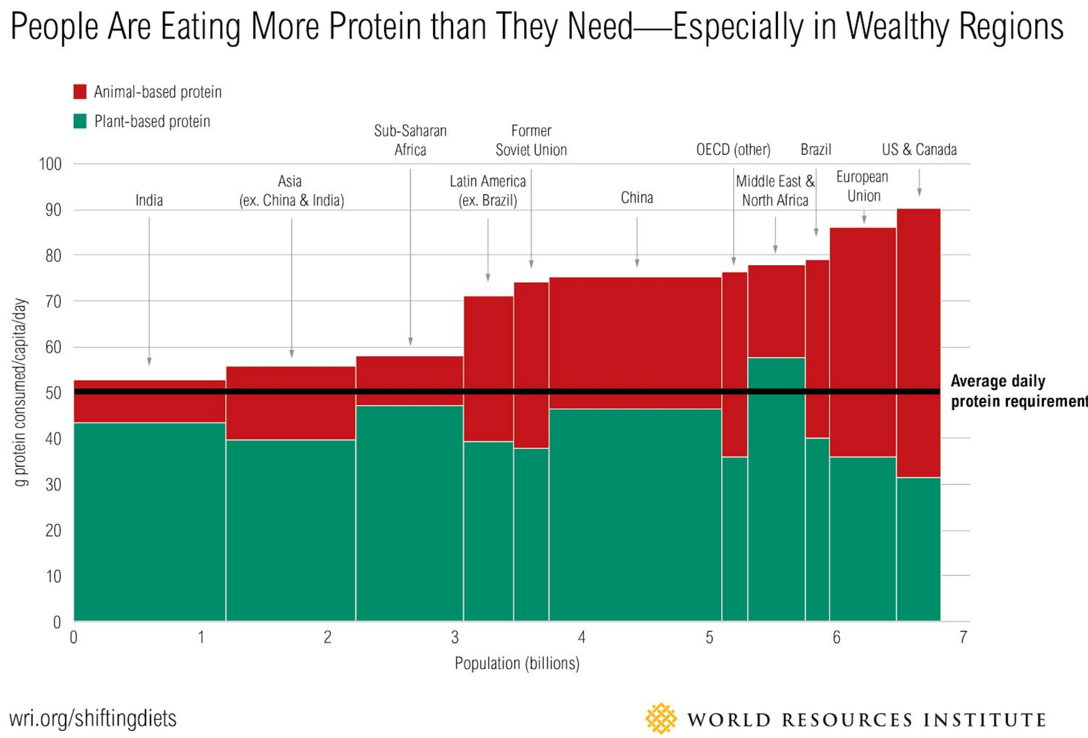

Figure 2. Protein requirements for healthy human life is 50 grams daily. United States citizens consume an average of 90 grams per capita, per day. Only a third of that intake is from plant protein. Data from the Middle East and North Africa demonstrates that average consumers can obtain a day's worth of protein from plant sources. Source: Ranganathan 2016.

Attitude towards alternative protein

Hartmann et al. (2015) compared the attitudes of Germans and Chinese towards the consumption of insects to better understand why western cultures were resistant to certain foods, even when that food was nutritious and cheap. There were no significant differences between ages, genders, or education level- the only significant difference were Chinese participants admitting to consuming insects in the past. Hartmann et al. (2015) demonstrated that cultures must evolve, and education may not be enough to convince people to overcome social inhibitions.

El-Beltagi et al. (2017) conducted a study comparing pizza quality with protein content. This study uses dried carp powder and chickpea flour as a substitute for predetermined percentages of the flour in a typical pizza dough (El-Beltagi et al. 2017). It was determined that at low quantities, the consumers could not tell the difference or even liked the altered pizza better, along with consuming more protein and more nutrients with the altered crust. Exact percentages were calculated which kept the integrity of the crust and didn't compromise texture while delivering protein and nutrients.

This approach could be helpful in the slow change of western ideals, as many participants listed pizza as their favorite food (El-Beltagi et al. 2017). Nutrient rich and high protein sources can replace flour without compromising on taste or texture.

Alternative Proteins

Plant Protein

On average, leafyv green vegetables only contain 1-2% protein in their caloric makeup- the vast majority of plant macros are carbohydrates. (Nurzynska-Wierdak 2015). However, there have been techniques identified that could produce leafy greens which are up to 16% protein and have an increase in nutrients overall (Nurzynska-Wierdak 2015). The plant could now successfully carry all essential amino acids if modified. Seaweed also contains a moderate amount of protein and can be grown in tropical waters worldwide (Gjedrem at al. 2012). Legumes and nuts remain a traditional source of plant protein (Polak et al. 2015).

Insect protein

Insects have many nutritional benefits- a good source of protein, calcium, and iron, and many essential fatty acids (de Oliveira et al. 2017). The specific nutrition will vary across insect species. Insects commonly consumed are between 30-60% protein, measured from dry mass. Common culinary insects are also higher in fat, averaging between 20-30% (Dobermann et al 2017). These statistics are comparable to chicken meat in protein and fat composition. Insects also require much less feed and care than cattle or other meat sources. Cattle require 8 kg of feed for every kg of meat produced, where insects only require 2 kg of feed to produce the same (Dobermann et al. 2017). Cattle are also inefficient because there are many parts unfit for human consumption. With insects, the whole insect may be consumed, and reproduction rate is fast and inexpensive (Dobermann et al. 2017). A study infusing wheat bread with insect flour to increase nutrient content found that with 10% or less of cockroach flour being used, there was no significant difference in texture, hardness, or taste (de Oliveira et al. 2017). With so many types of bread on the market, this could be an easy way to increase the protein consumption of an average citizen with an unrefined palette. (de Oliveira et al. 2017). A large hurdle facing the industry, besides consumer attitudes, is digestibility of protein. Insects have exoskeletons of chitin, which decreases the digestibility of the protein (Dobermann et al.). With the chitin removed, the quality of the protein improved significantly. However, like any other business, adding a step in the production line will increase cost, as well as decrease the dry mass obtained (Dobermann et al 2017).

Marine Protein

Aquaculture is one of the fastest growing global industries, with an average increase of 9.6% annually over the past several decades (Reilly and Kaferstein 1999). Much of growing aquaculture has its base in Asia. This industry provides livelihood for millions of small farmers, especially as the industry is beginning to rely on farmed aquaculture rather than fresh caught (Reilly and Kaferstein 1999). Certain aquaculture can provide high protein contents. There are several marine candidates to consider- mollusks, krill, jellyfish, and octopus. Each has its own positives and negatives, with varying associated cost and nutrition. Similar to the animal agriculture industry, selective breeding may be used on any of these marine candidates (Gjedrem et al. 2012). This would increase efficiency and yield, cut cost, and may increase nutrient content and protein percentages (Gjedrem et al. 2012).

Bivalve mollusks are already a regular part of eastern diets (Jaquet 2017). Nutritional information was summarized by Minju and Chakraborty (2017), who classified the bivalves studied to be high in protein and low in saturated fat. Methods of collection can be found in Minju and Chakraborty (2017), including specific information of vitamins and minerals. Bivalves also have minimal impact on their ecological surroundings, and require little feeding (Jaquet 2017).

Octopi could be another source of marine protein. The issue with this approach is that octopi are very smart and have ingenious problem solving skills (Estevez 2014). They are also difficult to feed when born in captivity. It has been proposed to capture juvenile octopi from the wild and cultivate from there, but then the cost is raised (Estevez 2014). Putting aside these challenges, the octopus is lean seafood, low in calories and high in nutrients. A 3 oz serving of octopus has 25g of protein, compared to 21g of protein in the average 3 oz of steak (Coffman 2017).

Jellyfish are already a multi-million dollar industry in the global economy, and techniques are being researched in order to produce edible jellyfish en mass (Khong et al. 2015). Jellyfish could be a good choice because certain species can be found year round. Nutritionally, jellyfish are low in calories and fat, and high in water and protein content (Khong et al. 2015). One of the major concerns of this industry is the high water content of the species- between 95 and 98% of these jellyfish are made up of water, leaving behind a surprisingly small amount of dried material (Khong et al. 2015). Although this dried mass is high in protein, it does not carry all essential amino acids like other marine examples (Khong et al. 2015). In order to make this protein source sustainable, there will have to be significant economic investment to expand farmed jellyfish outside of eastern Asia. In some areas of China, jellyfish has become popular enough to overtake shrimp in the aquaculture (Khong et al. 2015).

Krill is commonly known as a food source for whales, squid, fish, and other marine life. Krill meat is available for human consumption, but the industry is not widespread or popular at the current time (Tou et al. 2007). The nutrition analysis resembles the nutrition of shrimp. In traditional agriculture, higher protein content is associated with higher fat content but with krill, the fat content is a small 1.5%, compared to lean beef with 26% fat (Tou et al. 2007). Because of this low fat content and high antioxidant levels, krill protein is high quality and nutritious (Tou et al. 2007). Unfortunately, as with most other potential marine protein sources, the overall meat yield is low in comparison to catch weight, as krill have an exoskeleton made of chiton, which is also comparable to shrimp. While the exoskeleton does not provide additional protein, it is edible and provides fiber (Tou et al. 2007).

Study

Objective

Many dietary studies have been conducted to link human health with different food sources. This study will determine the health outcomes of switching to alternative proteins instead of consuming the typical American diet. This will be a short term study, lasting only 4 weeks. The goal of the study will be to determine whether replacing meat, eggs, and dairy with alternative protein sources will be detrimental to human health. It will be hypothesized that there will be no significantly different outcomes in health based on the type of protein consumed.

Materials and Methods

Subjects

Methods for gathering participants are modified in part from Bevc and Silverman (2000). Advertisements for the study will be placed in major newspapers in Milwaukee, WI, stating that volunteers are needed for a study pertaining to alternative diets. A phone number will be provided. An online advertisement will also be placed on recipe websites, with permission, including an email to contact for more information (Milwaukee county residents only). Callers and emailers will give their name, age, gender, height, weight, current diet and list their allergies. If respondents have allergies to shellfish, nuts, or dairy they will not be able to participate. Longtime vegans will not be able to participate. Respondents will also be restricted from participating if they are undergoing treatment for cancer, an autoimmune disease, or are pregnant. Respondents with high blood pressure or heart disease may participate with permission of their doctor. Additional volunteers will be recruited from UWM, Marquette University, and the Medical College of Wisconsin. Students and professors are equally encouraged to volunteer, and will meet the same allergy, illness, and medication requirements as the call-in volunteers. All volunteers will be given a monetary incentive to participate, and will receive their blood tests and physicals at no cost to the participants. Once 400 participants are gathered, they will be randomly sorted into 4 cohorts of 100 each. Each cohort will follow a separate specific diet- a typical American diet, a vegan diet, a vegan diet supplemented with insect protein, and a vegan diet supplemented with marine protein. Participants will be assured of anonymity and will be sent a copy of the results after the completion of the study.

Diets

Participants will adhere to their normal daily caloric intake, and continue their normal exercise routines during this study. Participants will aim to consume between 45-65% of their daily calories from carbohydrate sources, between 20-35% from fat, and between 15-25% from protein (Australian… 2017). If participants deviate severely from these guidelines, their results will be disqualified (i.e. participant eats 80% of their calories from carbohydrates for 5+ days in a row, participant never eats more than 5% protein daily during the entire study). Disqualified participants and reason for disqualification will be noted in the appendix of the study.

Each participant will track their daily food intake using an app called "MyFitnessPal" (MyFitnessPal 2018). Participant will use a scale (provided at no cost to participant) to measure their food portions in grams for better tracking. This app allows recipes to be created with individual ingredients, which will be helpful when the ingredients are unorthodox. Before the study begins, there will be a short tutorial on how to use the app, and the researchers will help the participants create their recipes.

For participants on the insect diet and marine diet, foods that are difficult to purchase on the open market will be provided and subsidized by the researchers. Recipe books will also be provided to participants on the insect, marine, and vegan diets. Participants on the typical American diet must have at least two servings of meat or eggs per day, and at least 2 servings of dairy. On the marine and insect diet, lunch or dinner must include the specified protein.

Participants will stay on their assigned diet for 4 weeks.

Biochemical Measurements

On the first day of the study, after fasting, venous blood samples will be obtained to run a biochemical analysis, which includes analysis of RBC[1], WBC[2], hemoglobin, hematocrit, creatinine, BUN[3], uric acid, and blood cholesterol levels. Vitamin levels will also be analyzed, focusing specifically on vitamins B12, A, C, Calcium, and Iron. Another blood sample will be taken at the conclusion of the study. Blood samples will be analyzed and cataloged immediately. Data will be treated with Mean±SD within the cohort and input into Table 1 in the appendix.

Participants BP, BMI, heart rate, and body fat percentage will be taken the first day of the study. These measurements will be retaken after 2 weeks on the specified diet, and again at the conclusion of the study. (Yen et al. 2008, Kim et al. 2012)

Statistical Analysis

Participants with significant amounts of data missing will be excluded from the study. Data will be analyzed using SPSS, available through Augustana College. Differences in demographics, caloric intake, protein intake, and biomedical measurements will be analyzed using Student's *t*-test. When data results were unevenly distributed, differences will be determined by the Mann-Whitney rank test. Values used will be Mean±SD. Pearson correlation will be used to assess relationships between protein intake and BP, and between protein intake and blood cholesterol. An additional

---

[1] Red Blood Cells, [2] White Blood Cells, [3] Blood Urea Nitrogen

t-test will be used to analyze change in blood cholesterol over the course of the study based on diet type. For Pearson tests, individual data collected post-study will be used. Results will be considered significant if $P<0.05$. (Yen et al. 2008, Kim et al. 2012)

Conclusion

This study will show whether health is adversely affected by excluding conventional protein from the diet. Each substitute protein will be found nutritionally adequate or rejected as such. Researchers will discover negatives and positives of each protein source from a medical perspective. Limitations of this study are the participants, who may be untruthful or have outside sources act upon them to unpurposefully alter the results. Unfortunately researchers cannot control for every aspect of outside life. The data from this study will help Americans understand that people can live healthy lives without protein from traditional animal products.

Bibliography

Adams L. 2006. Headed for louisville: rethinking rural to urban migration in the south, 1930-1950. Journal of Social History. 40(2): 407-430.

Agriculture: animal production. [Internet]. 2018 Jan 17. United States Environmental Protection Agency. [2018 Jan 20]. Available from: https://www.epa.gov/agriculture/agriculture-animal-production

Anderson K, Kuhn K. 2014. Cowspiracy. [videorecording]. AUM films, First Spark Media.

Australian Government. 2017. Recommendations to reduce chronic disease risk. National Health and Medical Research Council [online]. [cited 2018 Feb 2]. Available from: https://www.nrv.gov.au/chronic-disease/summary

Bevc IL, Silverman IL. 2000. Early separation and sibling incest: a test of the revised westermarck theory. Evolution Human Behavior. 21(3): 151-161.

Braithwaite V. 2010. Do fish feel pain?. New York: Oxford University Press.

Bryce E. 2017 Dec 8. Dietary recommendations for a warming planet. Anthropocene [online]. [cited 2017 dec 14]. Available from: anthropocene.com.

Campbell TC, Campbell TM. 2005. The china study: the most comprehensive study of nutrition ever conducted and the startling implications for diet, weight loss and long term health. Dallas: BenBella Books.

Coffman MA. The nutrients in octopus. SFGATE [online]. [cited 2018 Jan 7]. Available from:http://healthyeating.sfgate.com/nutrients-octopus-3006.html

Committee on Considerations for the Future of Animal Science Research; Science and Technology for Sustainability Program; Policy and Global Affairs; Board on Agriculture and Natural Resources; Division on Earth and Life Sciences; National Research Council. Critical Role of Animal Science Research in Food Security and Sustainability. Washington (DC): National Academies Press (US); 2015 Mar 31. 4, Global Considerations for Animal Agriculture Research. Available from: https://www.ncbi.nlm.nih.gov

Daniel CR, Cross AJ, Koebnick C, Sinha R. 2011. Trends in meat consumption in the united states. Public Health Nutrition. 14(4): 575-583.

De Oliveira LM, Lucas AJS, Cadaval CL, Mellado MS. 2017. Bread enriched with flour from cinereous cockroach. Innovative Food Science and Emerging Technology. 44: 30-35.

Dobermann D, Swift JA, Field LM. 2017. Opportunities and hurdles of edible insects for food and feed. Nutrition Bulletin. 42: 293-308.

El-Beltagi HS, El-Senousi NA, Ali ZA, Omran AA. 2017. The impact of using chickpea flour and dried carp fish powder on pizza quality. PLoS ONE. 12(9): 1-15.

Estevez JI. 2014 Aug 29. Tantalising tentacles: octopus could be the next big thing in aquaculture. The conversation [serial online]. [cited 2018 jan 7]. Available from: theconversation.com

Gerber PJ, Steinfeld H, Henderson B, Mottet A, Opio C, Dijkman J, Falcucci A, Tempio G. 2013. Tackling climate change through livestock- a global assessment of emissions and mitigation opportunities. Rome: FAO of the UN.

Gjedrem T, Robinson N, Rye M. 2012. The importance of selective breeding in aquaculture to meet future demands for animal protein. Aquaculture. 350: 117-29.

Hartmann C, Shi J, Giusto A, Siegrist M. 2015. The psychology of eating insects: a cross-cultural comparison between Germany and China. Food Quality and Preference. 44: 148-156.

Herrero M, Havlik P, Valin H, Notenbaert A, Rufino MC, Thornton PK, Blummel M, Weiss F, Grace D, Obersteiner M. 2013. Biomass use, production, feed efficiencies, and greenhouse gas emissions from global livestock systems. PNAS. 110(52): 20888-20893.

Institute of Medicine (US). 2001. Human health and the natural environment. In: Rebuilding the unity of health and environment: a new vision of environmental health for the 21st century. Washington, D.C.: National Academies Press.

Jacquet J. 2017 Jan 23. Why oysters, mussels and clams could hold the key to more ethical fish farming. The Guar [online]. [cited 2018 Jan 10]. Available from: theguardian.com

Khong MNH, Yusoff FM, Jamilah B, Basri M, Maznah I, Chan KW, Nishikawa J. 2015. Nutritional composition and total collagen content of three commercially important edible jellyfish. Food Chemistry. 196: 953-60.

Kim MK, Cho SW, Park YK. 2012. Long-term vegetarians have low oxidative stress, body fat, and cholesterol levels. Nutrition Research and Practice. 6(2): 155-161.

Leiserowitz A, Maibach E, Roser-Renouf C, Rosenthal S, Cutler M. 2017. Climate change in the American mind. New Haven: Yale University.

Minju J, Chakraborty K. 2017. Nutritional qualities of the low-value bivalve mollusks paphia malabarica and villorita cyprinoides at the estuarine waters of the southwestern coast of India. Journal of Aquatic Food Production and Technology. 26(1): 54-70.

MyFitnessPal. 2018. UnderArmor. [Mobile application software]. Version 7.30.1. Available from: myfitnesspal.com

Nurzynska-wierdak R. 2015. Protein nutritional value of rocket leaves and possibilities of its modification during plant growth. Turkish Journal of Agriculture and Forestry. 39: 1023-8.

Pelletier N, Tyedmers P. 2010. Forecasting potential global environmental cost of livestock production 2000-2050. PNAS. 107(43): 18371-74.

Polak R, Phillips EM, Campbell A. 2015. Legumes: health benefits and culinary approaches to increase intake. Clinical Diabetes Journal. 33(4): 198-205.

Ranganathan J. 2016. People are eating more protein than they need- especially in wealthy regions. [Image]. World Research Institute. Available from: http://www.wri.org/resources/charts-graphs/people-eating-more-protein-wealthy-regions

Reilly A and Kaferstein F. 1999. Food safety and products from aquaculture. Society for Applied Microbiology. 85: 249-257.

Runge CF. 2007. Agriculture of corruption. The American Interest. 2(3).

Satiji A, Bhupathiraju SN, Spiegelman D, Chiuve SE, Manson JE, Willett W, Rexrode KM, Rimm EB, Hu FB. 2017. Healthful and unhealthful plant-based diets and the risk of coronary heart disease in U.S. adults. Journal of the American College of Cardiology. 70(4): 411-422.

Standard American Diet. [Internet]. NutritionFacts.org. [2018 Jan 20]. Available from: https://nutritionfacts.org/topics/standard-american-diet/

Sylvetsky AC, Edelstein SL, Walford G, Boyko EJ, Horton ES, Ibebuogu UN, Knowler WC, Montez MG, Temprosa M, Hoskin M, Rother KI, Delahanty LM. 2017. A high-carbohydrate, high-fiber, low-fat diet results in weight loss among adults at high risk of type 2 diabetes. Journal of Nutrition. 147(11): 2060-66.

Thompson B. 2017. Water need for food. [Image]. African Climate Reality Project. Available from: http://climatereality.co.za/meat-the-cause-of-the-drought/

Tou JC, Jaczynski J, Chen YC. 2007. Krill for human consumption: nutritional value and potential health benefits. Nutrition Reviews. 65(2): 63-77.

Westhoek H, Rood T, Berg MVD, Janse J, Njidam D, Reudink M, Stehfest E. 2011. The protein puzzle- the consumption and production of meat, dairy, and fish in the european union. The Hague: PBL Netherlands Environmental Assessment Agency; p 144.

Yen CE, Yen CH, Huang MC, Cheng CH, Huang YC. 2008. Dietary intake and nutritional status of vegetarian and omnivorous preschool children and their parents in Taiwan. Nutrition Research. 28: 430-436

APPENDIX

Table 1. SAD (standard american diet), VEG (vegan diet), INS (vegan diet supplemented with insect protein), and MAR (vegan diet supplemented with marine protein) measurements both pre- and post- study.

	SAD (pre)	SAD (post)	VEG (pre)	VEG (post)	INS (pre)	INS (post	MAR (pre)	MAR (post)
BMI	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD
BP	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD
Heart Rate	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD
Body fat %	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD
RBC	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD
WBC	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD
hemoglobin	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD
hematocrit	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD
creatinine	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD
BUN	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD
Uric acid	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD
Blood cholesterol	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD
Vitamin B12	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD
Vitamin A	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD
Vitamin C	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD
Calcium	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD
Iron	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD	M±SD