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Veganism and animal welfare, scientific, ethical, and philosophical arguments

Daniel Mota-Rojas[a] | Alexandra L. Whittaker[b] | Leonardo Thielo de la Vega[c] | Marcelo Ghezzi[d] | Karina Lezama-García[a] | Adriana Domínguez-Oliva[a] | Isabel Falcón[a] | Alejandro Casas-Alvarado[a] | María Alonso-Spilsbury[a]

[a]Neurophysiology, behavior and animal welfare assessment. DPAA. Universidad Autónoma Metropolitana, Unidad Xochimilco, Mexico City 04960, Mexico.
[b]School of Animal and Veterinary Sciences, University of Adelaide, Roseworthy Campus, SA 5116, Australia.
[c]Animal welfare certification "Certificação Produtor do Bem"; F&S Consulting. São Paulo 04532-060, Brasil.
[d]Animal Welfare Area, Faculty of Veterinary Sciences (FCV), National University Central of Buenos Aires Province (UNCPBA), Tandil, Buenos Aires 7000 Argentina.

Abstract The justification for this review article is to understand the position of vegans and those individuals who consume food of animal origin from an unbiased perspective but with a grounding in scientific evidence. This will provide people who eat meat with scientific and ethical arguments to defend their alimentary autonomy in the context of the moral conflict that has emerged in societies regarding the consumption of meat and animal products, which is criticized –sometimes even attacked– by activists, ovolactovegetarians, or vegetarians with alimentary habits that stress ethical and moral respect for animals. These individuals refuse to eat meat and animal products but sometimes show disrespect for those who do. In recent decades, veganism and vegetarianism have reached an apogee in some western societies where they are often considered a healthy option for humans that simultaneously fosters animal and environmental welfare. While those diets may provide numerous benefits, they can also entail health risks by failing to provide balance and necessary dietary supplements. Various researchers concur that they are not appropriate for pregnant women, children, or carnivorous or omnivorous pets. Our review of scientific articles in favor and against dietary regimens that lack protein of animal origin leads to the conclusion that these dietary changes, on their own, do not reduce animal suffering or the contamination generated by the meat, dairy, and poultry industries. Finally, it is important to consider that, despite the popular opinion that vegetarianism and veganism are healthy diet alternatives, the diet must be individualized and well-balanced according to each stage of their life cycle.

Keywords: alimentary autonomy, animal suffering, vegetarianism, animal welfare, meat consumption

1. Introduction

In the Pleistocene, hominids had omnivorous diets that included meat-eating. Hunting provided a means of belonging to a society that, in turn, offered protection against predators and the guarantee to obtain food (Rose and Marshall 1996). Sharing the seeking for food with other members of society decreased the time to obtain food resources, consequently leading to higher survival rates (Hawkes et al 2018). Nowadays, many humans enjoy eating meat but may have concerns about harming animals considered sentient with a degree of intelligence (Bastian et al 2012). As a result, the number of vegans and vegetarians has increased markedly in recent decades (Iguacel et al 2019). The term "vegetarian" was established in the mid-20th century by the Vegetarian Society to refer to dietary options that avoided some or all animal-based foods (Barr and Chapman 2002); thus, it is not only a form of nutrition but also a lifestyle and philosophy (Tuncay and Bulut 2019).

On the other hand, the definition of "vegan" includes individuals who do not consume any product of animal origin (red meat, poultry, fish, eggs, dairy products, honey, gelatin, etc.) (Ruby 2012). It has been suggested that there are neurological, attitudinal, and behavioral differences between vegetarians and vegans (Rothgerber 2015; Kessler et al 2016; Rosenfeld 2019). For example, vegans tend to be more comprehensive in their attitudes to the environment, the effects of their food choices on animal welfare, and political issues related to it (Kessler et al 2016; Fiestas-Flores and Pyhälä 2018; Rosenfeld 2019).

The motivations that lead to adopting these diets are varied and can be religious, ethical, food, health, aesthetic, emotional, social, and political. Thus, for example, Leonardo da Vinci – genius of the Renaissance – was a vegetarian for ethical reasons and totally rejected unnecessary suffering. Nietzsche and Salt, who, in addition, hated domestication (Azpitarte 2020), and Nobel Prize winners, dramaturgs John Maxwell Coetzee (Coetzee 2002) and Sir George Bernard Shaw also adopted vegetarian diets. In India, large population sectors (35%) consume vegetarian diets because of cultural and religious traditions, but percentages in western countries are much lower (Michalak et al 2012). Hindus prefer a vegetarian or lacto-vegetarian lifestyle and food production systems that are humane, natural, compassionate, and

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respectful of other life forms. According to the holy scriptures and the association between the soul and food choices, the wellness of the soul is related to an appropriate diet. Contrarily, the soul can be affected when eating the wrong foods (e.g., alcohol and meat), deleteriously impacting how people act. At the top of the Hindu caste system are the "Brahmins", usually mostly vegetarians, to supposedly maintain good karma. In the lowest rung of the caste system are the so-called "impure" who are often associated with the consumption of the cheapest meat (pork and buffalo) and who have negative karma, condemning them to tasks such as the manual collection of feces (Granados 2018). While some people consider vegetarian or vegan diets healthy, others consider them excessively restrictive and nutritionally deficient (Judge and Wilson 2015). Data on this topic shows that most vegans are female (74% in the U.S., 66% in Germany, 63% in the U.K.), they tend to be liberal or left-leaning in their politics, have higher educational levels than omnivores, and live in urban rather than rural areas (Martinelli and Berkmanienė 2018).

Health arguments are often used to support the adoption of a non-meat-containing diet. However, there are pros and cons to both vegetarian and meat-containing diets. Vegetarians can have a lower body mass index than omnivores (Fraser 1999; Mota-Rojas et al 2018), and vegetarians and vegans have more disciplined alimentary habits. In contrast, research has demonstrated no significant differences in nutritional or physical activity levels between vegetarians and omnivores (Nascimento et al 2018). However, vegans and vegetarians have better gastrointestinal functioning (Ostrowski et al 2018). Conversely, studies show that vegetarianism can increase the risk for impaired cerebral and corporal development in fetuses and children (Cofnas 2019), as well as mental disorders like depression and anxiety (Michalak et al 2012), and dermal problems (Ostrowski et al 2018).

As an extension to their thinking, some vegans who own or care for animals have opted to impose vegan diets on their pets, resulting in carnivorous animals being fed plant-based diets, despite their physiology and nutritional needs. The suitability of these diets for pets is questionable since research shows that they fail to satisfy the minimal requirements of essential nutrients that are found primarily in products of animal origin (Zafalon et al 2020), such as vitamin B12 (cobalamin), which can be obtained only in foods of animal origin (Pawlak et al 2012). A study by Dodd et al (2019) found no published evidence of the beneficial effects of vegan diets for the metabolism of canines and felines, but that –as in humans– there are risks of dietary insufficiency that can predispose animals to develop diverse pathologies.

A key factor in adopting veganism for many is a concern for the welfare of animals raised for consumption and the suffering they experience in production systems (Warner 2019; de Haas et al 2021). Some authors, however, have argued that abstaining from eating meat does not directly impact the welfare of those animals because it does not lead to any change in production units (Bruckner 2020).

This brief review considers health-related and ethical issues around non-meat-based diets based on a series of common questions: why are veganism and vegetarianism becoming so popular?; are vegetarian or vegan diets beneficial for human health?; can they be adopted without negative outcomes on the health of children and pregnant women?; can being a vegan or vegetarian contribute to improving animal welfare?; can these diets significantly aid in reducing environmental contamination and global warming?; and are they healthy options for carnivorous or omnivorous pets?

2. Materials and Methods

A structured literature search was conducted in Scopus, Web of Science, Science Direct, and PubMed databases. Identification of relevant articles was performed using the following keywords: "alimentary autonomy", "animal suffering", "vegetarianism", "animal welfare", and "meat consumption". Included were articles that describe veganism diets and philosophy, which discuss the pros and cons of being vegan or omnivore. There was no restriction on the publication date for article selection. The search was conducted in multiple languages. The search methodology and the selection of the 218 references used for this review are described in Figure 1.

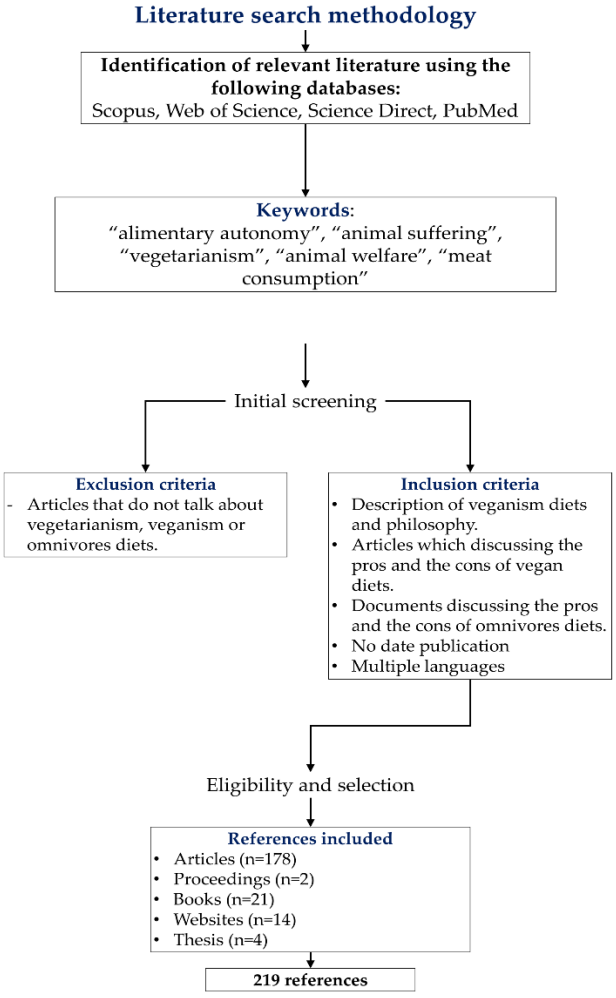

Figure 1 Literature search methodology.

3. Differences between being vegetarian and vegan

Vegetarians and vegans are commonly grouped in nutritional and psychological research (Rothgerberg 2017). However, a range of terminologies around dietary patterns need clarification (see Figure 2) (Le and Sabaté 2014; Melina et al 2016). Vegetarian and ovolactovegetarian diets exclude meat, seafood, and poultry (Melina et al 2016; Cofnas 2019). Both vegetarian and vegan diets entail restricted consumption of animal-based products of animal origin. Still, the primary difference between them is that vegetarians exclude only meat, while vegans reject all animal-based products, including red meat, chicken, fish, eggs, dairy products, honey, and even gelatin (Ruby 2012).

Moreover, they do not use products made from animals' skin, hair, or fat, such as wool or silk, or products tested on animals (Tuncay and Bulut 2019). Ovolactovegetarians consume eggs and dairy products but do not eat meat. In contrast, ovo-vegetarians eat eggs and avoid dairy products or meat. Lacto-vegetarians consume dairy, restrict the consumption of meat, eggs, or honey consumption, and refrain from using animal skin or fat products. Pescatarians, finally, consume fish but no other products of animal origin like meat, eggs, or honey, nor do they use products made from animal skin or fat (Messina and Messina 1996; Petti et al 2017).

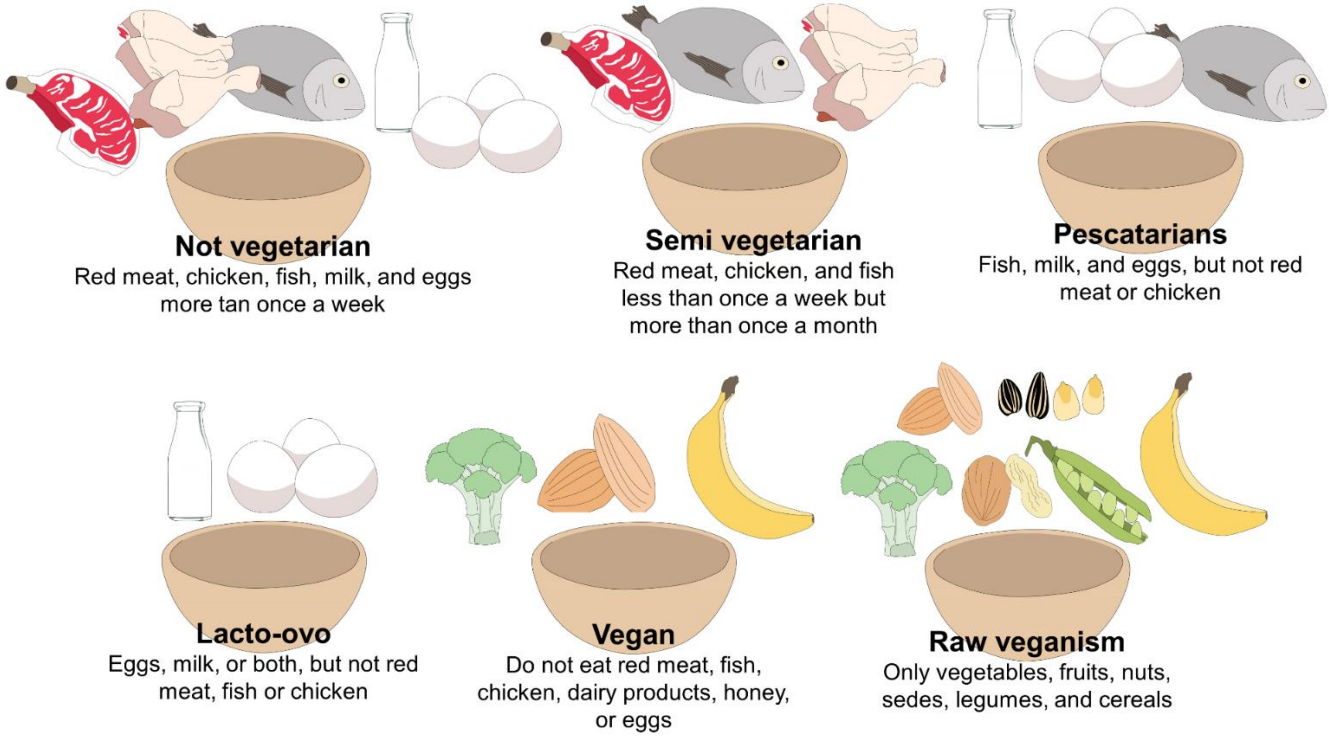

Figure 2 Differences among the forms of vegetarianism and veganism.

4. Does being vegan make me more humanitarian?

The growing acceptance of veganism and vegetarianism raises a fundamental question: what drives people to adopt these lifestyles? In addition to religious reasons, some studies of vegetarians have identified several non-religious reasons for choosing meat-free diets, including health and weight loss benefits (Wilson et al 2004), repugnance, the association of meat consumption with patriarchal values, and the influence of family customs (Petti et al 2017). According to the patriarchy, women are considered property that should be at the service of men. Therefore, from the feminist position, patriarchy is seen as morally wrong and morally unacceptable. This concept can be extended to non-human animals that may be treated as tools for human benefit in production systems.

Additionally, most of these animals are female, disrupting the ethical principle of equality (Tovar 2011; Ruiz Carreras 2019). To these, we can add a range of ethical issues (Lea and Worsley 2001; Hines 2010; Pickett 2021) since these lifestyles also seek to prevent the harm and cruelty that animals raised for consumption suffer (Fessler et al 2003) and to improve their welfare (Jabs et al 1998; Houwer and Bruycker 2007; Le and Sabaté 2014). There are also ecological aspects; Beardsworth and Keil (1991) wrote that avoiding meat can reduce the environmental pollution of intensive meat-producing systems. Generally, intensive systems are viewed in a more negative context. However, the environmental impact, evaluated as a Life Cycle Assessment of milk production systems, has been reported by Battini et al (2016), who determined that the total greenhouse gas (GHG) emissions from livestock differ, depending on the type

of production systems, being 1.47 eq/kg in very intensive and 1.50 eq/kg in units based on grassland crops. Similarly, Sintori et al (2019) report that in extensive dairy goat systems, the GHG emissions are higher per produced milk (4.08 kg CO2-eq) than semi- or intensive systems (2.04 and 1.82 kg CO1-eq, respectively). A final element involves questions of social and cultural pressure in societies where being thin and healthy are held as virtues (Beardsworth and Keil 1991). A 1992 study reported that 46% of vegetarians cited health concerns for their choice, 15% were pro-animal, 12% mentioned the influence of family or friends, 5% cited ethical reasons, and 4% had environmental concerns. The other 18% referred to other reasons (Pribis et al 2010). There is evidence of shifts in attitudes with 89.4% of respondents in a recent study, stating that the main reason for "going vegan" was to improve animal welfare. Individual health was cited by 69.3%, while 46.8% were motivated by environmental factors (Walsh 2013) (Table 1).

Table 1 Reasons for dietary change.

Pribis et al (2010)	Walsh (2013)	Cramer et al (2017)
46% health issues	89.4% improve animal welfare	75.4% general wellness or disease prevention
15% favor animal rights	69.3% personal health	57.6% improve energy
12% influence of family or friends	46.8% motivated by environmental factors	23.8% improve athletic performance
5% ethical reasons		50.6% improve immune function
4% environmental reasons		27.6% improve memory or concentration
18% other reasons		

Source: Elaborated by the authors.

5. Ethics and the consumption of meat and protein

The principal argument of the vegan ethic is that humans must have the moral integrity to cease harming animals by slaughtering them for food and utilizing them in laboratory tests (Carr and Winslow 2001) and to practice compassion and magnanimity in our relations with animals and the planet as a whole. People who become vegans often start by questioning issues that lead them to reject meat and adopt this diet as a form of humane lifestyle (Alvaro 2017).

According to the U.S. Environmental Protection Agency, around 70% of the decay of rivers and lakes can be attributed towaste from farm animals. No question that raising livestock for human consumption entails land degradation (Bekele et al 2021), air pollution, the loss of biodiversity (Morand 2020), global warming (Reisinger and Clark 2018), and contributes significantly to carbon dioxide, methane, and nitrous oxide emissions (Bryant 2019). When addressing sustainability, it is said that four considerations exist in the livestock sector: food security, animal health, economic growth, and climate/natural resources) (Schneidere and Tarawali 2021). Currently, consumers and their perceptions of sentience and animal welfare can impact the sustainability of food chain systems (Alonso et al 2020). In animal production systems, aside from greenhouse gas production, other issues that compromise sustainability include reduction in carbon sequestration and increased water pollution, adverse effects on human and animal health, inappropriate killing methods for animals, inefficient usage of the land, and inequal trade between producers from different countries or regions (Broom 2021). The OIE (2017) and the World Health Organization (2021) have recognized that sustainable livestock development contributes to animal-friendly practices prioritizing welfare as a comprehensive approach to human well-being and the environment. From this ecological perspective, veganism and vegetarianism could be seen as options that help reduce these problems (Davidson 2012; Hedenus et al 2014; Hallström et al 2015). Another common argument relates to the livestock industry's large-scale use of antibiotics to promote animal growth. However, those antimicrobial residues could result in bacterial antibiotic resistance and toxicity in consumers when they are deposited in meat and eliminated via excreta into the environment (Muhammad et al 2020). This ultimately complicates treating human disease and increases morbidity and mortality (Economou and Gousia 2015). The use of probiotics, phytobiotics, or combinations as alternative growth promoters has been proposed in broilers to minimize these concerns (Ferdous et al 2019). After further research and development, these options may also be suitable for other animal industries.

Technological advances now make it possible to create specific parts of the bodies of animals and humans in the laboratory. Apart from the obvious moral concerns this raises –which we do not address here– it generates a true ethical dilemma around producing of synthetic meat for human consumption. Vegans typically argue that eating meat and using animal-based products is ethically immoral due to (i) the pain animals can feel and (ii) intensive production being a major cause of environmental degradation and pollution. Nonetheless, as previously discussed, the environmental impact caused by farming systems depends on the type of system and its sustainability (Skaf et al 2019), where, contrary to what one may expect, extensive farms contribute to a higher percentage of GHG emissions and degradation due to pollution or soil erosion (Stringer et al 2020). Therefore, the production of synthetic meat in the laboratory appears to be an apt solution. While it is posed that if synthetic meat could taste just like "real" meat, then animals would no longer be required, and environmental

impact would be reduced, it is not that simple. Firstly, the environmental effect of deriving cultured meat based on land use does not differ greatly from conventional animal-based systems. As stated by Alexander et al. (Alexander et al 2017), new alternatives to current animal production systems, such as poultry, can have a major environmental benefit and actually promote sustainable land use compared to that of generating synthetic meat.

Additionally, the plant-based resources necessary to extract and produce synthetic meat are not negligible (Ismail et al 2020). On the other hand, the raw material required to produce synthetic meat includes cells from animal meat, so animals would still be necessary for the process and continue to be exploited. On this topic, Warner (Warner 2019) calculated that producing the 50L of serum needed to make one hamburger would require between 91 and 333 bovine fetuses that would be subjected to precisely the kinds of activities that vegans seek to prevent. Finally, it still remains necessary to determine if this is financially feasible and morally acceptable (Bhat et al 2015; Alvaro 2019).

The scientific literature suggests that other factors impact the environment in addition to the meat industry (Kanianska 2016). When we consider that producing one ton of palm oil requires 0.2 hectares of land, one ton of canola oil 1.25 h, and one ton of soya 2 h (Mongabay and Paz-Cardona 2019), we can begin to see that opting to plant these kinds of crops would entail deforesting the planet. In terms of water, water footprint is a method to assess the impact of agricultural, industrial, and domestic water usage (Jeswani and Azapagic 2011). This concept is associated with the classification of freshwater types: 1) green water: the amount of precipitated and infiltrated water that is stored in the soil and used for crops and rangelands; 2) blue water as consumptive irrigation water withdrawn from surface and groundwater resources such as rivers, lakes, and aquifers, as a supplied method when green water is not sufficient; and 3) grey water as the amount required to assimilate or dilute human pollution (Rost et al 2008; Chapagain and Hoekstra 2011; Mubako 2018; Abbott et al 2019). Blue and green are considered the types of water used for agriculture and irrigation and represent almost 92% of the total human water footprint (Network 2022). Producing one kilo of meat requires 15,000 L of water, while one kilo of soya consumes only 1,800 L (Figure 3) (Hoekstra and Chapagain 2006, 2007; Koech and Langat 2018; Barquera et al 2020; Rojo 2021). While the provided levels of protein from meat-based foods (beef, tuna, pork, or chicken) are similar to 100 g of soya (between 38.6-51.1 g) (FAO and Agricultura 2012; Hopkins 2019; Agriculture 2020; Fun 2021) to produce the same amount of soya protein would demand 18,000 L of water. The question here is how many kilos of soya or other vegetables that provide protein would be needed to produce sufficient protein to replace that provided by meat and products of animal origin, and how many liters of water would be consumed for this purpose? Considering these factors it is clear that ceasing meat consumption is not the best option for helping animals or the environment.

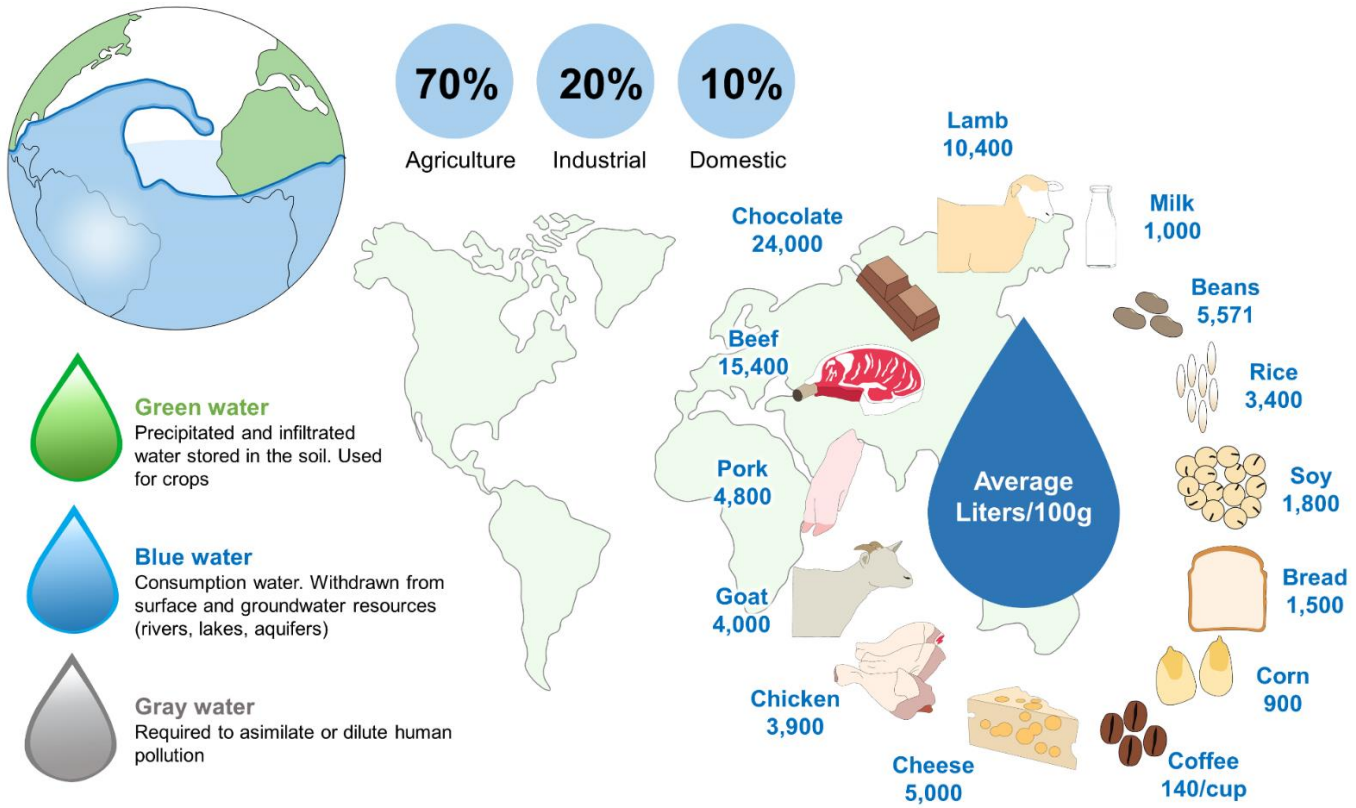

Figure 3 Water footprint and liters of water required to produce various foods.

Other important points to ponder are that 178 million children in the world under the age of 5 years suffer chronic malnutrition and that 35% of deaths in that population sector are due to malnutrition. In Mexico, 1.5 million children under this age suffer chronic malnutrition. Considering these figures, cow's milk is a valuable food based on its favorable cost/benefit ratio (Barquera et al 2020).

6. Advantages of being vegan for human health reasons: scientific findings

Becoming vegetarian or vegan emerged as a popular choice in the past decade due largely to certain studies demonstrating how this alimentation could improve human health. Some of those reports emphasized that ailments like heart disease (with a mortality rate 32% higher for coronary and ischemic diseases in non-vegetarians) (Key et al 1999; Crowe et al 2013), circulatory (Micha et al 2010) (and cerebrovascular diseases, type 2 diabetes (Barnard et al 2006; Vang et al 2008; Tonstad et al 2013) and some types of cancer (Key et al 2009), around 11-19% (Dinu et al 2017; Segovia-Siapco and Sabaté 2019) –especially colorectal, breast (Watling et al 2022), and prostate– and obesity, have significantly lower incidences in vegetarians than omnivores (Dewell et al 2008; Sinha et al 2009). Whole food plant-based diets provide advantages in reducing BMI (4.4) and cholesterol levels (0.55 mmol/l) as a part of a weight loss program (Wright et al 2017).

The cardiovascular benefits of vegan and vegetarian diets may be associated with high consumption of cereals, soya, nuts, and flavonoids (Mellen et al 2008). However, despite the widespread belief that vegetarian diets have the benefit of lowering blood pressure levels in comparison to omnivorous regimens, a study by López et al (2019) did not find any significant differences between vegan and omnivorous diets.

A study by Otrowski et al (2018) compared 1,209 individuals: 702 vegetarians, 365 vegans, and 142 subjects with no ethical diet restrictions. Vegetarian and vegan diets cause gastrointestinal signs like gas build-up, constipation, sensations of indigestion, and reduced appetite. While their results were favorable for the vegan and vegetarian diets regarding decreased digestive disorders, those subjects reported higher incidences of skin problems manifested as dry, flaky hair, fragile nails, and skin discoloration (Ostrowski et al 2018). The dryness can be due to the lack of specific fatty acids, vitamins, proteins, minerals, and nutrients such as omega-3, fats, zinc, iron, vitamin C, and vitamin A (McFarland 2020).

Other studies suggest that a varied, well-balanced vegan diet could be beneficial due to the increased consumption of fiber, magnesium, folic acid, vitamin C, vitamin E, iron, carotenoids, flavonoids, polyunsaturated omega-6 fatty acids, and antioxidants (Petti et al 2017), while greater ingestion of fruits and vegetables could be related to lower plasma cholesterol levels (Djoussé et al 2004; Barnard et al 2009; Key et al 2009), and thus, to a reduced risk of heart attack (Bazzano et al 2002). Burr and Butland (Burr and Butland 1988) conducted a study of 10,986 people, 4,671 vegetarians, and 6,225 non-vegetarians. They observed that mortality from ischemic cardiac disease was significantly lower in the former, and cholesterol levels and body mass indices were lower in 300 vegetarians (Burr and Butland 1988).

A 6-year study by Norat et al (2005) of a population of 478,040 women and men from ten European countries examined the correlation between the ingestion of processed red meat, poultry, and fish and incidences of colorectal cancer. Results showed that the risk of suffering this form of cancer was directly associated with consuming processed red meat and inversely proportional to consuming fish. No association with eating poultry was determined (Norat et al 2005). Based on those findings, there is good evidence that vegan diets reduce the risk of some forms of cancer and prevent some cardiac, cerebrovascular, and circulatory diseases and type 2 diabetes (Figure 4) (Yokoyama et al 2017; Olfert and Wattick 2018; Ostrowski et al 2018; Tong et al 2019).

However, as stated previously, veganism goes beyond the diet and is a lifestyle choice. Vegan philosophy includes the non-consumption of animal products and adaptation of clothing choices to consider the use of synthetic leathers, cotton, or synthetic fibers. Being vegan often entails a responsibility to consume natural products from small producers rather than processed foods from the supermarket industries (Prieto 2009).

7. Disadvantages of veganism for human health: scientific findings

The main disadvantages of vegan diets for humans include a tendency towards low levels of fat, polyunsaturated omega-3 (Saunders et al 2013) fatty acids, calcium, iodine (Lightowler et al 1996; Krajčovičová-Kudláčková et al 2003), zinc, vitamin B12, and vitamin D (Li 2011; Melina et al 2016), as well as deficiencies of creatine, taurine (Cofnas 2019), lysine, methionine (Young and Pellett 1994), and cobalamin (Stabler and Allen 2004), the latter a common cause of hyperhomocysteinemia in vegetarian populations (Hung et al 2002). Homocysteine is a sulfur amino acid produced by methionine metabolism (methionine-homocysteine-methionine), while vitamins B6, B9, and B12 are coenzymes of homocysteine whose levels are closely interrelated because vitamin B12 helps recycle them. Vegan diets are also high in folic acid which can, to a degree, mask low vitamin B12 levels so that this deficiency may be detected until neurological signs are present (Herrmann et al 2001). A vitamin B12 deficiency can also predispose humans to cardiovascular and cerebrovascular diseases (atherosclerosis, Alzheimer's, thrombosis) if hyperhomocysteinemia develops (Herrmann et al 2001; McNulty et al 2008). According to a study by Michalak et al. (Michalak et al 2012), vegetarians and vegans tend to present higher rates of mental disorders, such as depression, anxiety, and somatoform disorders. Their report concluded that vegetarian diets could benefit physical health, not mental health (Michalak et al 2012). Omega-3

fatty acid and vitamin B12 deficiencies are associated with depressive disorders. It is well-known that people who consume vegetarian and vegan diets present these deficiencies, which explains the reported incidence (Freeman 2000; Herrmann and Geisel 2002). In addition to nutritional disorders, however, sociodemographic and psychological factors need consideration in interpreting mental health issue prevalence since single women living in urban zones make up a significant proportion of vegans, with this group being found to be more at risk of mental health issues (Jacobi et al 2004). The evidence states that altered fatty acids and phospholipid metabolism is associated with psychiatric, neurological, and developmental disorders in adults. Essential fatty acids, ω-3 and ω-6 polyunsaturated fatty acids, are needed for normal development and functioning of the brain and central nervous system (Perica and Delaš 2011). Neuropsychiatric conditions such as Attention Deficit (Hyperactivity) Disorder, Alzheimer's Disease, Schizophrenia, and Depression have been reported with low levels of omega-3 fatty acids (Young and Conquer 2005; Michalak et al 2012).

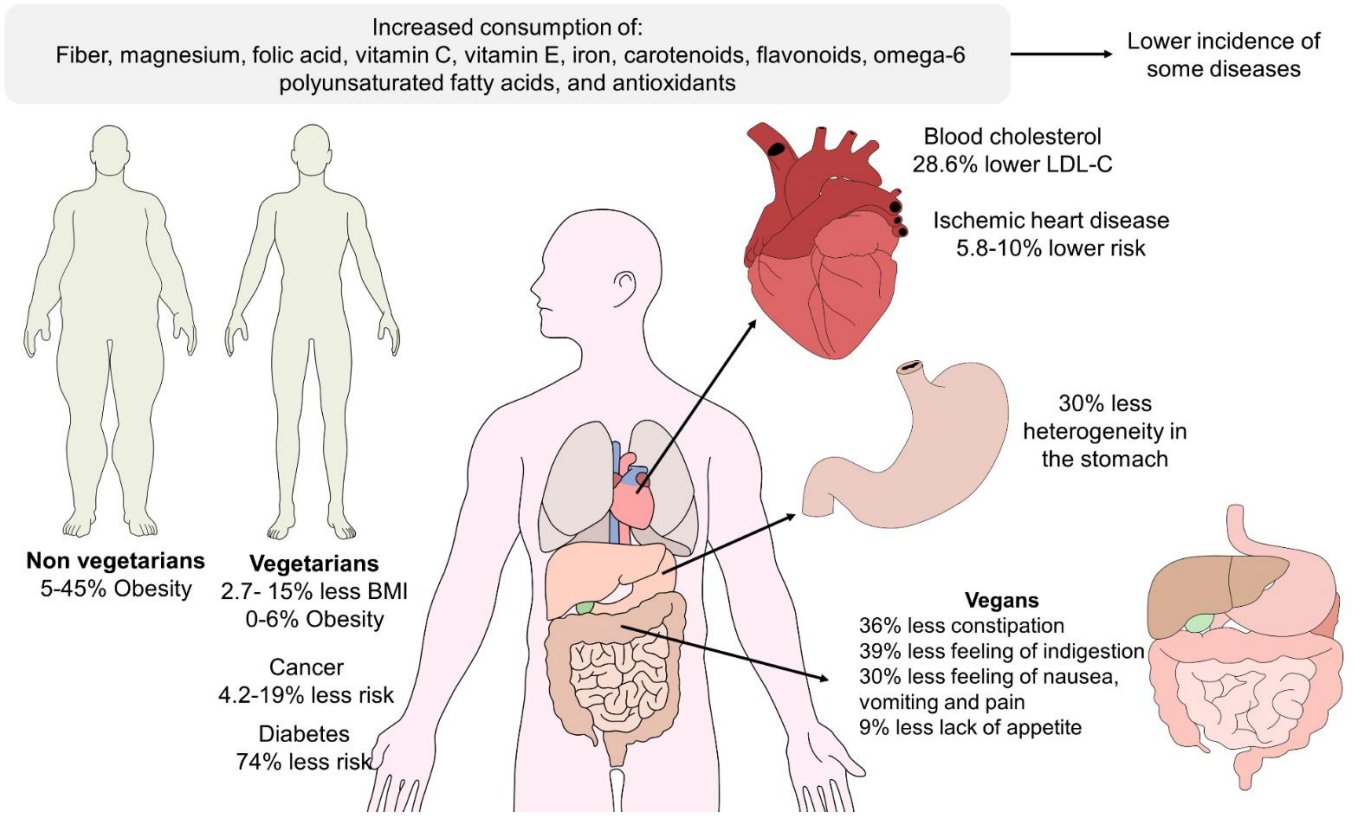

Figure 4 Positive health effects of veganism. This figure shows an increase in various nutrients upon adopting vegan diets and lower incidences of several diseases, including diabetes, obesity, various types of cancer, and numerous digestive and cardiovascular illnesses.

A study conducted by the Oxford European Prospective Investigation into Cancer and Nutrition (Tong et al 2019) observed that the risk of bone fractures between ovolactovegetarians and omnivores was similar but that vegans presented a 30% greater risk of such events, likely due to low calcium consumption (Appleby et al 2007; Veronese and Reginster 2019). However, when their diets are supplemented with adequate amounts of calcium, the incidence of bone fractures among vegans tends to decrease (McLean et al 2008). It is worth mentioning that older adults who adopt poorly balanced vegan diets can be at risk of adverse health outcomes and risk not achieving their daily caloric requirements. When choosing a vegan diet, protein, calcium, vitamin B12, and vitamin D must be supplemented (Melina et al 2016) since it is well known that, compared to proteins of animal origin, those from vegetable sources contain lower levels of essential amino acids. Moreover, the few amino acids provided cannot be utilized as efficaciously (Young and Pellett 1985). Figure 5 summarizes the possible disadvantages of vegan diets (Chen et al 2008; Michalak et al 2012; Iguacel et al 2019).

It is important to note that nutritional deficiencies are not exclusive to vegan diets. All diet patterns have shortfall nutrients; for example, a study comparing vegan and omnivorous diets and their iron deficiency concluded that vegetarians did not have a higher iron deficiency than omnivorous participants and that individual traits such as nutritional status and inflammation are elements that can alter this diagnosis, independent of the eating habits (Slywitch et al 2021). A recent systematic review that compared consumers of plant-based diets with meat-eaters found that although the former had lower protein intake, the parameters were within recommended levels. Likewise, vegan and vegetarian diets provided higher polyunsaturated

fatty acids, folate, vitamin C, E, and magnesium, while meat-eaters were at risk of not consuming appropriate fiber. Therefore, issues with nutritional deficiencies and the need for supplementation or knowledge of proper balancing are essential for all diets and are not restricted to vegans/vegetarians (Neufingerl and Eilander 2021).

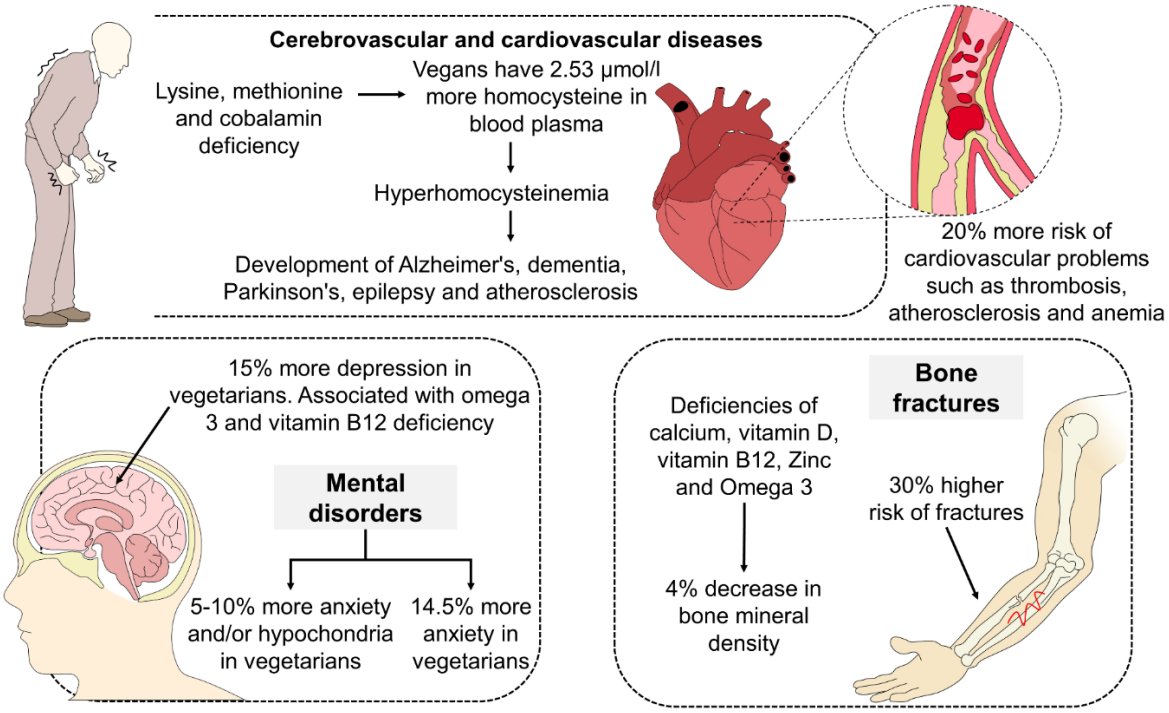

Figure 5 Negative health effects of veganism. This figure shows the predisposition to develop fractures, cardiovascular and cerebrovascular diseases, and mental disorders due to the nutritional deficiencies of vegan diets.

8. Veganism in children

The literature on the impact of veganism on children is conflicting. In contrast to the Academy of Nutrition and Dietetics (AND) and the U.S. Department of Agriculture (USDA), which have affirmed that vegetarianism does not have adverse effects on children, a study by Cofnas (2019) reported that it might impair cerebral and corporal development in fetuses and children. This risk cannot be solved with supplementation with iron, zinc, and vitamin B12 (Cofnas 2019). The AND does not mention the harmful effects that vegetarianism could cause during pregnancy; it also does not state that soy milk, legumes, and eggs are inefficient alternatives for meat or that vegetarian diets place the health of children at risk by causing deficiencies that can have consequences for their short- or long-term health, even though several studies have reported cases of malnutrition, poor growth, and even death among children who consume very strict vegan and macrobiotic diets (Zmora 1979; Shinwell and Gorodischer 1982). Alternately, a study by Weder et al (2019) in vegetarian/vegan and omnivorous children from 1 to 3 years showed that the first group obtained similar energy (937.9-1011.9, 978-1049, and 952.0-1017.3 kcal/d, respectively) and macronutrient intake in comparison to the last group, resulting in unaltered growth.

In their study in Kenya, Neumann et al (2007) formed four groups of children. Every day for 2.25 years, the normal diets of the children in three groups were supplemented with meat (60 g), milk (200 ml), or energy (3 g of oil). The fourth group was a control that did not receive supplements (Neumann et al 2007). Results showed that the group supplemented with meat achieved the highest intelligence scores, measured by Raven's Progressive Matrices (RPM), better academic performance, greater muscle growth, and the best physical and social performance. Similarly, fish meat intake in children, a rich source of long-chain fatty acids (e.g., eicosapentaenoic acid and docosahexanoic acid), has been associated with better cognitive performance (Demmelmair et al 2019; Lehner et al 2020). Contrarily, Haapala et al (2015) found that high consumption of red meat, sausages, and low consumption of high-fiber grains and fish cause poor cognitive abilities in children from 6-8 years.

Phytoestrogens, specifically isoflavones, are present in legumes at high levels, especially soya, so vegetarians and vegans tend to show increased concentrations of these in their blood compared to omnivores. Studies have documented that while high levels may have beneficial effects in adults, their impact on the health of children may be negative, including malformation of the ovaries, mammary glands, and prostate, early puberty, and reduced fertility (Patisaul and Jefferson 2010; Cofnas 2019), and hypospadias (North and Golding 2000).

An iodine deficiency during pregnancy and the first years of life can cause irreversible neurological disorders (Velasco et al 2018), while the deficiency of fatty acids like eicosapentaenoic (EPA) and decosahexaenoic acid (DHA) is related to several behavioral and developmental pathologies, including attention-deficit/hyperactivity (ADHD), dyslexia,

dyspraxia, and autism (Figure 6) (Krajčovičová-Kudláčková et al 2003; Neumann et al 2007; Schuchardt et al 2010; Sebastiani et al 2019; Hunt 2019; Cofnas 2019).

Phillips (2005) and Messina and Reed (Messina and Reed Mangels 2001) stress that careful dietary planning is necessary for children who wish to convert to veganism. They require an adequate energy supply, essential fatty acids, protein, calcium, and vitamin B12. Extreme macrobiotic diets have, in fact, been related to malnutrition and poor growth, so diets of this kind are not recommended for infants or children.

In addition to the nutritional imbalances that may affect children who practice veganism, depending on cultural context, vegetarian and vegan children may become targets of bullying and hostility that can have severe negative consequences, such as poor school performance, anxiety, depression, and poor social interaction (Wolke and Lereya 2015). Moreover, many cultures organize social activities and gatherings where meat is consumed, such as Christmas, birthdays, or Halloween. While vegan children are not excluded from such events, it is difficult for them to participate fully, and they may feel uncomfortable (Ciocchetti 2012; Hunt 2019).

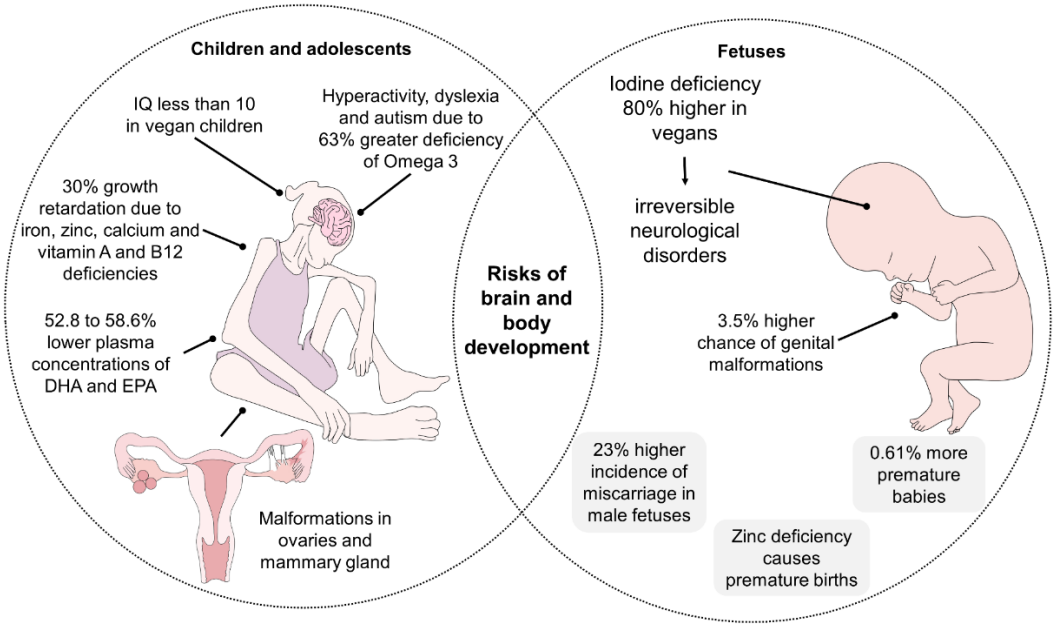

Figure 6 Adverse effects of veganism in pregnant women, children, and adolescents. This figure presents the negative effects of vegan diets during gestation and the possible consequences of these regimens for children and adolescents cerebral and corporal development.

9. Importance of consuming cholesterol for human reproductive performance (birth, lactation, gestation, sexual libido)

The onset of a woman's reproductive life is announced by her first menstruation (menarche). One study evaluated and compared the age of vegan and non-vegan girls at menarche and found no significant differences between the two groups. However, alterations to the menstrual cycle were more common in vegan girls (Barr 2001).

Gestation and lactation are nutritionally vulnerable stages for both mothers and babies. A recent study has reported lower birth weight babies where the mother is vegan (Abu-Assal and Craig 1984). The normal ratio of births of boys and girls (masculine/feminine) is 105:100 (Fukuda et al 1998), but observations show this decreases in vegetarian mothers. Environmental stress and malnutrition have been proposed to reduce the proportion of male children due to the observed incidence of spontaneous miscarriages of male fetuses among vegetarian women (Andersson and Bergström 1998; Bruckner et al 2015). A study by Hudson and Buckley (Hudson and Buckley 2000) evaluated almost 6,000 pregnant women, 5% of whom were vegetarians. They observed that the ratio of male children decreased considerably in those mothers (81.5:100 vs. 106:100). The authors concluded that the vegetarian mothers had a 23% lower probability of delivering children of masculine gender, a risk associated with spontaneous miscarriages, especially in male fetuses (Hudson and Buckley 2000).

9.1. Cholesterol

Cholesterol is a steroid substance in the blood that is vital for forming cellular membranes and hormones. Around 75% is produced in the liver; the rest is acquired through the foods we consume, including saturated fats and fatty acids (meat, butter, cheese, eggs, tropical oils) and hydrogenated vegetable fats (cookies, bread, potato chips, margarine, hydrogenated vegetable oils) (Maldonado et al 2012). Cholesterol is classified in two groups: 1) LDL (low-density lipoprotein), the so-called "bad" cholesterol because it obstructs the arteries, and 2) HDL (high-density lipoprotein), which is deemed "good" because it cleans excess LDL from the arteries (Maldonado et al 2012). Certain diseases and life-cycle stages can increase or decrease both types of

cholesterol; for example, LDL increases in cases of hypothyroidism, while HDL decreases in people with diabetes and during menopause (Huang et al 2014).

Refraining from consuming foods of animal origin may help reduce cholesterol levels. However, numerous other dietary and lifestyle changes can also achieve this. For example, taking 30 minutes of exercise per day, reducing consumption of foods high in saturated fats, salt, and sugar, eating two pieces of fruit and three vegetables a day, consuming dehydrated legumes and fruits, adjusting portion size, limiting alcohol ingestion, and not smoking (Shafiq et al 2010), among others.

The importance of cholesterol lies in that all the hormones secreted by the suprarenal cortex have a similar morphology and are steroids formed from acetate and cholesterol. These include the mineralocorticoids, steroids whose function has an important effect on the balance of sodium and potassium (aldosterone), glucocorticoids that participate in the metabolism of carbohydrates, lipids, and proteins (cortisol, cortisone, corticosterone), and the sex hormones, mainly weak androgens that contribute to the formation of secondary sexual characteristics (estrogens, progesterone, testosterone) (Vance 2000).

A study by Bloomer et al (2015) showed that when they administered modified, well-balanced diets to groups of vegans and non-vegans, no significant differences between the groups were observed in their cholesterol levels and concluded that while vegan diets can be beneficial for health, people who follow a well-balanced omnivorous diet can also obtain favorable results. Huang et al (2014), however, found that pre- and post-menopausal women who eat vegan and ovolactovegetarian diets tend to have markedly lower levels of both high- (HDL-C) and low-density (LDL-C) cholesterol. These authors suggest that the ovolactovegetarian diet may be better than the vegan diet for those women (Huang et al 2014) since HDL-C, total cholesterol (CT), triglycerides (TG), and (LDL-C) levels all tend to decrease in the postmenopausal period. Finally, low-fat vegetarian diets reduce glycemia and lipid levels (Barnard et al 2006).

9.2 Phytosterols

Phytosterols are substances found in nuts, legumes, and seeds. The most common ones are β-sitosterol, campesterol, and stigmasterol. Their structure is like that of cholesterol, so they have been incorporated into human and animal diets to reduce plasma cholesterol levels and, in this way, lead to favorable cardiovascular effects. They reduce LDL-C levels by decreasing cholesterol absorption in the intestines (Calpe-Berdiel et al 2009). However, observations have shown that these substances can cause reproductive problems. One study found that the testicular weight and semen quality of male rats decreased notably when they were fed β-sitosterol (Singh and Gupta 2016). The authors of a study of goldfish (*Carassius auratus*) found that when exposed to alimentation with β-sitosterol, their blood levels of sex steroids decreased, accompanied by a reduction in the gonadal capacity to perform steroidogenesis (Maclatchy and Vanderkraak 1995). Qasimi et al (2018) conducted studies with quails (*Coturnix japonica*) in which they administered phytoestrogens. They concluded that the adrenal glands and gonads preferred cholesterol for performing steroidogenesis (Qasimi et al 2018). The testicles use LDL-C for this purpose, and when vegan or vegetarian diets rich in phytoestrogens were provided, this type of cholesterol decreased, as did steroidogenesis. Lastly, a study by Chen et al (Chen et al 2019) found that although phytosterols can help reduce blood HDL-C and CT levels in some people, the same amounts can increase those levels in others. These authors concluded that vegan diets do not always aid in reducing cholesterol levels (Chen et al 2019).

10. Veganism in pets (companion animals)

While veterinarians may prescribe vegetarian diets for pets to treat hepatic encephalopathies, allergies, and urolithiasis caused by urates and cysteine (Kanakubo et al 2015), a study that analyzed a sample of 24 vegetarian pet diets found that only 12.5% were of therapeutic use, while the other 87.5% consisted of foods that were readily available to the public. The authors further observed that most diets did not comply with the labeling regulations of the Association of American Feed Control Officials (AAFCO), which raises questions about the suitability of the amino acids they contain (Kanakubo et al 2015). However, most vegetarian pets are not on this restriction under veterinary advice. A study by Dodd et al. (2021) that applied 3,673 questionnaires to dog-owners (51% n=1870), cat-owners (16% n=603), or both (33% n=1200) in English-speaking countries (Australia, Canada, New Zealand, U.SA., U.K.) identified that 22% (n=650) of the dogs and 4.7% (n=73) of the cats were fed vegan diets, of which approximately half (47% n= 302 dogs, 70% n= 51 cats) consisted exclusively of vegetables, while 6.8% (n=44) of the dogs and 15% (n=11) of the cats were fed only plants. In another study by Wakefield et al (2006), a comparison was made between 34 cats fed vegetarian diets and 52 fed conventional diets. Surveys were carried out on those responsible for these animals to determine their perception regarding the health of their pets. Taurine and cobalamin concentrations were also determined. According to their results, owners reported apparent improvements in the health of their animals, while cobalamin blood levels were not altered with vegetarian diets. However, taurine levels were decreased in 3 of the 17 cats evaluated.

10.1. Physiological attributes of dogs and cats

The domestic feline (*Felis catus*) and canine (*Canis lupus familiaris*) belong to the order of carnivores. Their ancestors subsisted mainly by eating prey, so diverse evolutionary adaptations emerged to promote the capture, apprehension, mastication, digestion, and absorption of animal-derived foods by providing those animals with senses to detect prey, a musculoskeletal system that facilitates capture (Knight and Leitsberger 2016), prominent canines to

hold, perforate, and tear the meat of their prey (Brown 2009), distinct digestive enzymes and intestinal flora, and short intestinal tracts compared to herbivores like rabbits or horses, all of which indicate that they are not designed to adapt to diets rich in the vegetable matter (Semp 2014).

However, these two species have significant differences, including their respective degrees of protein dependency. Cats are classified as "true" carnivores because they must obtain proteins of animal origin (Bernal 2019) and due to certain nitrogen-catabolizing enzymes in the liver that are permanently configured to maintain high levels of dietary protein. This means that cats have an even greater protein requirement than other mammals (Wortinger and Burns 2015) and require larger amounts of amino acids, taurine, arginine, methionine, cysteine, long-chain polyunsaturated fatty acids, and vitamin A (Zoran 2002; Dodd et al 2021).

Dogs have domesticated from wolves over 33,000 years ago and became increasingly dependent on human food remains. As a result, they underwent behavioral and physiological adaptations to a more varied diet that included vegetable foods. The domestic dog is considered an omnivore with a greater capacity to metabolize carbohydrates and subsist on low-protein diets. This is due to an increased genic expression of pancreatic amylase, the ability to transform maltose into glucose, and greater intestinal glucose absorption. These adaptations include a drastic increase of the AMY2B gene, which codifies the digestion of carbohydrates, thus favoring the capacity to convert maltose into glucose and increasing the capture of glucose in the intestines (Semp 2014; Knight and Leitsberger 2016; Kiemer 2019). But dogs also have postcarnassial molars for grinding vegetable matter. These molars are well-developed in omnivores but are absent in true carnivores like cats (Brown 2009). In addition to the absence of molars, cats do not possess the genetic, biochemical, and behavioral changes that allow dogs to adapt to omnivorous diets. This may be attributable to the fact that cats were domesticated only around 10,000 years ago and have often been utilized to control animal plagues, so their capacity to adapt to mixed human food is deficient (Knight and Leitsberger 2016).

Despite our knowledge of the physiology and metabolism of carnivores, approximately 1% of cat-owners and 21% and 5%, respectively, of vegan and vegetarian pet-owners choose to feed their cats completely vegan diets (Dodd et al 2019, 2021), generally adducing ethical reasons, due to anthropomorphic practices, or because they consider that it will benefit their pets' health. Another explanation, however, could be the so-called "vegetarian's dilemma": the uncomfortable situation of living with a carnivorous pet. The simplest and most obvious solution to this quandary is simply to feed pets vegetable-based diets (Buff et al 2014; Dodd et al 2019, 2021; Zafalon et al 2020).

10.2. Scientific evidence of the effect of vegan diets on dogs and cats

Zafalon et al (2020) evaluated the fatty acid, amino acid, and mineral profiles of vegan foods available for cats and dogs in markets in Brazil (three for dogs, one for cats). They compared them to the requirements for these species using laboratory analyses that determined the required profiles. Their results indicated that all the foods analyzed exceeded the legal limit for copper and, significantly, that the levels of potassium, arginine, protein, and taurine in the cat food were all below the recommended minimal daily allowances. Regarding dog foods, one of the products tested failed to00 comply with the minimum recommendation for methionine (Zafalon et al 2020). Those findings suggest cats fed vegan diets are susceptible to arginine, protein, and taurine deficiencies. Arginine deficiencies in cats have been associated with the development of severe uremia and hyperammonemia, which cause symptoms like ataxia, emesis, hyperesthesia, and muscle spasms. In contrast, the chronic deficiency of essential fatty acids in food can affect the animals' skin, including causing alopecia (Mota-Rojas et al 2021b).

Protein deficiencies are especially concerning because cats cannot conserve nitrogen in their bodies and present greater obligatory urinary nitrogen loss when fed low-protein diets (Case et al 2010). A taurine deficiency (<200 nmol/ml) may go undetected because its clinical signs vary and may be absent. In severe cases, however, it manifests in central retina degeneration, fetal reproductive insufficiency, deteriorated fetal development, or dilated myocardiopathy (Larsen and Fascetti 2020).

A study by Kiemer (2019) evaluated the health of vegan dogs trying to determine the impact of a vegan diet under more controlled conditions. Blood samples collected from dogs (n=40 dogs aged 10 months to 15 years) that had consumed a vegan diet for between 3 months and 10 years were analyzed for total protein, folic acid, vitamin B12, calcium, iron, magnesium, L-carnitine and taurine levels. Serological and hematological tests were also conducted, with the results being compared with dogs fed meat-based diets. The dogs' owners also filled out questionnaires. Fecal volume increased according to 41.7% of owners, with the remainder reporting no change or unaware of a change. Reports on general health were largely positive, with 66.7% of owners stating that this had remained the same, or possibly improved, since they began the diet, while 29.2% noted an improvement in their pets' general health. The study detected only two folic acid deficiencies in the vegan dogs (diagnosed as giardia), in contrast to the control (meat-based diet) group, where folic acid (n=4), vitamin B12 (n=4), calcium (n=2), and iron (n=1) deficiencies were apparent (Kiemer 2019).

Organic heme iron (formed from the hemoglobin and myoglobin in foods of animal origin) is absorbed more efficiently than non-heme iron (from vegetable sources and some foods of animal origin) (Case et al 2011). Iron deficiencies can develop gradually, and dogs and cats can often adapt and compensate for even severe anemia without manifesting any clinical signs beyond pale mucous membranes. However, if the condition worsens, clinical signs of lethargy, weakness, weight loss, intolerance to exercise,

generalized malaise, and pica may be observed (Naigamwalla et al 2012).

It is important to note that despite the lack of evidence of health impact from Kiemer's work (2019), it is well-known that vitamin B12 (cobalamin) is found only in foods from animals and that it participates in the transference of individual carbon units during several biochemical reactions and the metabolism of carbohydrates and lipids. Moreover, it is necessary for myelin synthesis (Case, Daristotle 2011). Therefore, vitamin B12 deficiencies in puppies and adult dogs can cause clinical signs like loss of appetite, anemia, neutropenia with hypersegmentation, and megaloblastic anemia. In kittens, anorexia and "moist" fur have been reported (Sean and Fascetti 2012), as well as comorbidities such as chronic gastrointestinal disease, lethargy, vomiting, weight loss, and polyphagia (Kook et al 2020).

One of the main concerns in providing vegan diets is the alkalization of the urine. Because plants are deficient in acidifying amino acids, the pH of the urine of vegan pets increases, predisposing them to form crystals (mainly struvite) that can produce urolithic syndromes in cats or they are equivalent in dogs, partial or complete obstructions, dysuria, and hematuria (Knight and Leitsberger 2016). When animal products are metabolized, an acid pH is produced with high amounts of DNA and RNA, forming the uric acid that acidifies the urine. However, a marked decrease in pH predisposes animals to form calcium oxalate crystals (Kiemer 2019), resulting in changes in pH that can induce a higher prevalence of urinary infections caused by alterations in the bacterial flora that require constant monitoring of urinary pH. A pH above 7 indicates alkaline urine in cats since normal pH is 5.5-7, while in dogs, it is 5-7 (Semp 2014; Knight and Leitsberger 2016). These findings are important because at least 38% of dog-owners who feed their pets plant-based diets are unaware of the increased urinary pH (Kiemer 2019).

Vitamin A is considered an essential requisite for cats. Still, deficiencies have been recorded when fed vegan diets due to their inefficiency in converting β-carotene into active vitamin A. This means that adequate dietary supplementation is required since this vitamin plays a role in normal processes of vision, growth, reproduction, immune function, and the expression and regulation of numerous genes. Unlike cats, dogs utilize the carotenoid precursors of vitamin A (e.g., beta-carotene) and convert them into retinol (Semp 2014).

Concerning minerals, studies have found that calcium (Ca) deficiencies in dogs and cats can produce secondary nutritional hyperparathyroidism (SNH) that, in turn, can cause rubber jaw syndrome, a series of injuries characterized by the loss of the lamina dura of the teeth that loosens them, osteopenia of the bones that can lead to fractures, and muscular spasms and convulsions (Zafalon et al 2020). Despite these deficiencies of vegan dog diets, Brown (2009) affirms that nutritionally adequate meat-free diets can be developed.

Expert veterinarians and nutritionists sustain that vegetable-based diets are not safe for cats but are less dangerous for dogs due to the evolutionary differences mentioned earlier. However, those diets must be formulated carefully because the margin of error is high (Domínguez-Oliva et al 2023). If not prepared correctly, they can be inadequate compared to diets containing some animal protein (Figure 7) (Rothgerber 2014; Knight and Leitsberger 2016; Zafalon et al 2020). While it is true that to date, there are no published cases of complications in cats fed vegan diets, the time for clinical signs to develop with these nutrient deficiencies may be protracted and may even go unnoticed (Dodd et al 2019). It is concluded that it is difficult to achieve a vegan diet in cats that is nutrient-rich and promotes health without adding additives or supplements. Although commercial vegetarian diets for animals must have supplements and additives, there is often a lack of quality control, and the nutritional information on the labels often differs from reality (Zafalon et al 2020). Furthermore, owners often implement diets themselves, without consulting veterinarians for specialist nutritional advice (Buff et al 2014; Mota-Rojas et al 2021b).

While most animal welfare laws are silent on the specific requirements for companion animals' diet- beyond that, it should be suitable and adequate, Germany has taken an unusual stance of stipulating the type, consistency, nature, and amount of food that should be supplied for animals concerning species, age, and physiological needs. Those laws also state that people who care for pets must feed them according to their species. A vegan diet may not meet these requirements if a pet-owner risks adopting it without first consulting a qualified veterinarian. Legislation of this kind, therefore, imposes the responsibility on veterinarians to inform people of the pros and cons of vegan diets and the nutrients and supplements that may be required (Semp 2014).

11. What can be done to improve animal welfare?

The philosophical arguments that sustain that producing animals for consumption –and consuming them–is wrong reflect the widespread, severe, and unnecessary harm those animals suffer (de Haas et al 2021), which compromises their mental and physical welfare (Bruckner 2020). For this reason, companion animals and livestock production enterprises face ethical challenges based on the ethics of killing animals and the suffering that commonly occurs during routine production practice (Mota-Rojas et al 2018; Mota-Rojas et al 2023). This point of view is often embraced by vegans and vegetarians who have the possible misperception that all animals raised on farms or in intensive production systems suffer (Warner 2019). However, by logical extension, it follows that it may be morally acceptable to consume products from animals raised humanely (Neo 2016). Ursin (2016) observed that providing good living conditions for animals destined for human consumption, and using appropriate slaughtering procedures, was able to reduce pain

and suffering and could represent a solution to this moral dilemma.

Nonetheless, although there are recommendations from official institutions such as the OIE to prevent livestock from suffering in their productive life, this is a prevalent issue in most farming systems (Bockman 2019). The recognition of animals as sentient beings increases the concern about the potential pain that animals destined for food production could experience (McLennan 2018) such that this is an issue that goes beyond a simple legal or procedural aspect regarding the quality of life and generates a moral dilemma around the consumption of animals. Piazza (Piazza 2019) states that eating animals is a "blind spot" for ethical thinking, where the perception and thinking bias decide which animals need legal protection from suffering.

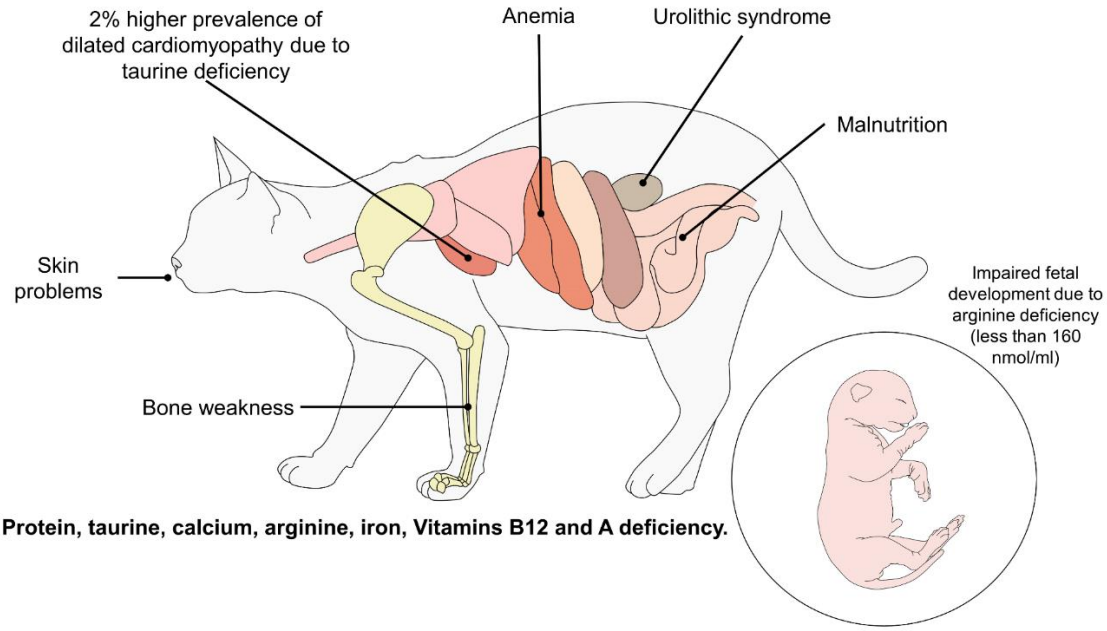

Figure 7 Adverse effects of vegan diets for pet health. Adverse effects are generally caused by deficiencies of nutrients that are essential for pets in general. Cats (*Felis catus*) seem to be the species most seriously affected due to evolutionary adaptations that have made them "true" carnivores, unlike their omnivore counterpart, the dog (*Canis lupus familiaris*).

Animal welfare assessment based on scientific opinions is part of the approach to improve the quality of life and death and the conditions of farm animals, where welfare and its evaluation is a multidimensional concept, as stated by The European Food Safety Authority (EFSA) (2012b). These include reports and recommendations on housing transport and slaughter of farm animals to improve their welfare. Current regulations and requirements include behavior, body condition, and health issues associated with husbandry practices and welfare (EFSA 2012b). Endocrine, physiological, and behavioral parameters can be animal-based measures to assess welfare (EFSA 2014b). These assessments can assist farmers and veterinarians in improving the management of animals and mitigating negative effects or hazards that arise in production systems (EFSA 2012a). Transport is known as one of the most stressful events for livestock. Since it is an almost mandatory event in their productive life, regulations and recommendations exist for domestic animals' mobilization. These prescribe physical requirements of the vehicle, space allowance, training for humane handling during loading and unloading, the journey duration according to the species (e.g., a maximum of 29 hours for cattle), and the type of containers (EFSA 2011). Slaughter or killing is also controversial for every farm animal due to the pain animals could experience. While there has been much research into mitigating welfare impacts during these processes, even with the successful implementation of these strategies, it is unlikely that these events will ever have a nil impact on welfare, meaning these ethical issues will always persist.

Furthermore, welfare issues are also common on the farm across many industries. For example, in ewes, welfare impacts include mastitis, thermal stress, and lameness; in lambs, pain caused by management procedures, gastro-enteric disorders, thermal stress, neonatal disorders, and respiratory disorders (EFSA 2014a). In rabbits, the welfare consequences of on-farm slaughter are significant (Saxmose Nielsen et al 2020). with issues related to unsuccessful killing, poor stockperson ship, and inadequate design of facilities (Nielsen et al 2020).

However, it is also important to consider whether vegan and vegetarian activists have asked themselves what would happen to the billions of animals currently in production; where could sufficient, adequate land be found to allow them to roam freely?; who would care for their health, especially in light of the catastrophes caused by climate change?; and what effects would this have on natural resources because of the contamination they generate? The answer from the perspective of biocentrists or abolitionists is

that it would be neither sustainable nor ethical to maintain all those animals until they die of natural causes, quite apart from the fact that the environments into which they might be released could have carnivores that would prey on them. Stated simply, their longevity would make this practice unfeasible (Alonso-Spilsbury 2019). We must consider that calves can have a longevity of 25-30 years but are slaughtered at the age of just one or two; pigs that can live for 15 years are slaughtered at 6 months; lambs, similarly, may live for 15 years, but are slaughtered at 3-10 months; while chicken that can reach age 10 years, grow and fatten so quickly that they are slaughtered at just 6 weeks of age. From this perspective, people who eat meat often appeal to the "logic of the larder" proposed by the moralist writer Sir Leslie Stephen (Stephen 2021) (father of Virginia Woolf). One premise of this intellectual of the Victorian aristocracy and his "logic" is that slaughtering animals is morally permissible, even obligatory if they have led pleasant lives. Stephen (2021) argued that we are doing animals a favor by buying their eggs, milk, and meat because if we did not, then few of them would need to exist. The "logic of the larder" reflects the commonly-held view that supplies of farm animals follow the demand for their products and the notion –less often expressed– that the world is a better place when more animals exist. Several contemporary thinkers defend this argument, including ethologists like Mike Appleby (1999), Grandin (2002), and the philosopher Peter Sandøe et al (1999).

One of the great detractors of the "logic of the larder" was Henry S. Salt (1914), a vegetarian, pacifist, opponent of vivisection, and pioneer of the animal rights movement, as well as Francione (2009), a contemporary philosopher, among others. In their opinion, the argument did not hold because it assumes that animals should exist than not. However, this was not the case because animals often suffered on farms. A practical argument is also appealed to since it is posed that many more human lives can be supported by land that grows grain and fruit instead of animal rearing. In contrast, Gruzalski (1989) declared, from a utilitarian perspective, that being vegetarian was not only absurd but may also be counterproductive. He argued that the effect of marginal vegetarianism would be to lower the price of meats, to which producers would react by intensifying production that –feeding the worst fears of many vegetarians– would entail subjecting animals to even greater suffering.

From an economic perspective, it is important to consider that government intervention through regulation and information policies are needed to create awareness of the characteristics of products of animal origin and to enforce measures that contribute to reducing the number of animals affected by the meat industry and improving their quality of life (Azrak and Charlebois 2020). Moreover, people must understand that the dietary choices of a few individuals have no impact on the harm generated by the production and consumption of animal products; a handful or people who stop eating chicken, for example, will in no way affect the number of chickens produced or prevent harm (Bruckner 2020). Other measures are required to ensure the welfare of production animals, such as implemented and strictly enforced codes to ensure that industry standards are met (Azrak and Charlebois 2020). Regulatory reforms and legislation governing the production, transport, and slaughter of farm animals could contribute, especially if accompanied by inspection and certification programs, training courses for handlers, initiatives of corporate social responsibility for restaurants that include inspections to ensure that suppliers comply with standards and, finally, improving the technology in production systems by, for example, adding electronic feeding systems for gestating sows and providing environmentally-enriched cages for egg-laying hens, to mention just two (Fraser 2008). The goals are to allow animals to express their natural behaviors and improve their functioning and quality of life (Orihuela et al 2018), all to promote higher levels of welfare with acceptable levels of productivity to satisfy consumer demand and the economics of the business (Figure 8) (McInerney 2004).

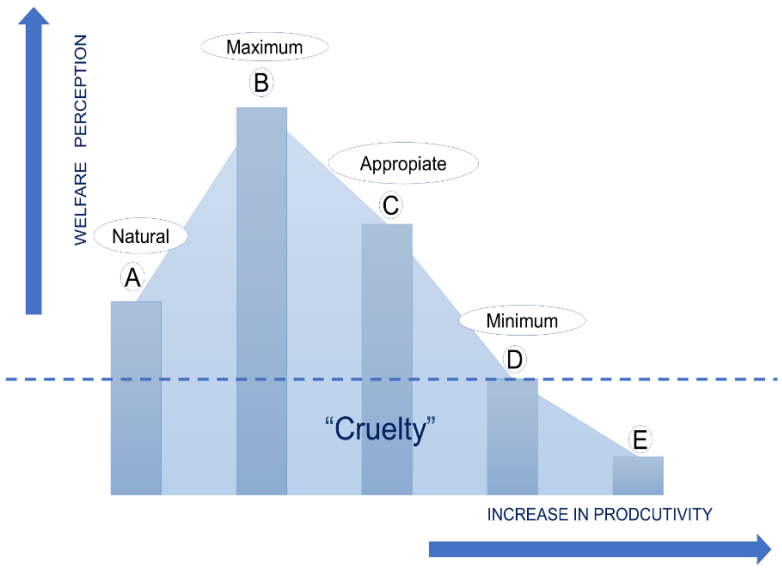

Figure 8 Perceptions of animal welfare and cruelty. Based on a report by McInerney, we can state that an intimate relation exists between greater productivity that benefits humans and current perceptions of animal welfare. Here, we can initially appreciate a "natural" welfare, where the systems are not particularly concerned about exploiting animal productivity; therefore, these units have no specific pro-welfare management (A). Contrarily, when farmers adopt husbandry procedures, preventive medicine, and enhance feeding and housing elements, this leads to maximizing welfare and productivity (B). However, with an increase in production, we perceive a decrease in the level of animal welfare; initially, even with this decrease, it remains at an appropriate level (C) until, at a certain moment, this exceeds the minimal parameter (D) and becomes cruelty, indicated by any parameter that falls below the dotted line (E).

12. Final considerations

While many studies have considered the benefits and disadvantages of vegan and vegetarian diets in relation to health, findings are often contradictory. Given the pervasiveness of these dietary choices within the global population, there is now the perfect opportunity to conduct large, longitudinal studies around this question. While the jury is still out, vegan and vegetarian diets likely offer beneficial effects like improved digestion, reduced risk of some cancers, and improved circulation, with a diminished incidence of infarctions and cerebrovascular accidents. They also have disadvantages, including putting proponents at an increased risk of mental disorders like depression and anxiety, somatomorphous disorders, malnutrition, reduced bone density that increases the risk of fractures, and dermatological and reproductive problems. In addition, most authors point out that these kinds of diets should not be provided to children or infants because they can cause brain damage and retard physical, mental, and social development. They are inadequate for pregnant women as well.

Carrying out a vegan or vegetarian diet is a personal and free decision. However, from a scientific perspective, to avoid health issues, experts in the area, such as nutritionists, are consulted, and the specific requirements of each individual considered. Another point to consider before converting to veganism is the cost of alimentary supplements, certain vegetables, and other dietary inputs. A financial analysis is required to determine if it is feasible to maintain the diet chosen. While veganism does present many health benefits, it also entails risks and deficiencies. All diets that do not include products of animal origin must be perfectly well-balanced and adequately supplemented, but even taking these measures does not eliminate the possibility that health problems may develop due to the lack of essential amino acids. The fact that these diets have become popular in recent decades should spur peoples' interest in researching and analyzing them to increase their awareness of deficiencies and so supplement them more efficiently.

Whether vegan or vegetarian diets improve animal welfare is even more controversial since many strategies and tools exist to increase welfare levels so that animals live in greater comfort. The fact that some humans stop eating meat does little to allow animals in intensive production systems to enjoy a better quality of life. The application of positive reinforcements, such as giving food or having contact, often promotes learning in farm animals (Rochais et al 2014) and may stimulate physiological reactions that can be interpreted as "anti-stress effects" (Lürzel et al 2015). This is one of the strategies to improve the quality of the human-animal relationship (Mota-Rojas et al 2020). Indeed, improvements in animal welfare, ecology, and the environment will be reflected more actively when we can ensure that current legislation is being adhered to in abattoirs, meat production units, aviculture operations, and laboratories to guarantee ethical production, accompanied by efficient stunning methods that ensure the quality of death of animals (Mota-Rojas et al 2012, 2021a, b, c). Another way would be to implement alternative production systems that allow animals to satisfy their biological and emotional needs better. Since these animals are being raised for human consumption, if people stop eating meat, overproduction will ensue. We would need to decide the fate of those animals to prevent the terrible effects of banning animals in circuses, for the vast majority of those animals were abandoned or died. We conclude that ending meat consumption is not the only measure to improve animal welfare.

Another question of importance relates to the ethics around imposing vegan/vegetarian diets on carnivorous pets. Research suggests that diverse adverse effects may occur, such as nutrient deficiencies, dermal issues, bone fractures, anemia, malnutrition, urolithic syndromes, and reproductive deficiencies, amongst other elements that negatively affect their welfare. We must recognize that, upon considering all the factors involved in humans becoming vegan, this diet does not function in the same way in animals whose thousands of years of evolution cannot simply be ignored, nor can we set aside the nutrient needs of pets by following tendencies or accepting beliefs that compromise their health and quality of life. We must be aware that a great deal of disinformation circulates and that people can commit grave errors in nutrition if they change an animal's dietary habits without consulting specialists. In Latin America, only 10% of pet-owners visit nutritionists; the rest obtain information from Internet sources. It is important that people not be led astray by the current popularity of these diets and their own ethical beliefs without awareness of the consequences for their animal companions.

Finally, we recommend that omnivore readers practice responsible consumption and develop the respect that the food they consume merits by not wasting it, keeping in mind that a sentient, conscious being was slaughtered for their alimentation and nourishment. Only in this way can we eat meat and exercise our right to alimentary autonomy.

Ethical considerations

Not applicable.

Conflict of Interest

The authors declare that there is no conflict of interest with this work.

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References

Abbott BW, Bishop K, Zarnetske JP, Minaudo C, Chapin FS, Krause S, Hannah DM, Conner L, Ellison D, Godsey SE, Plont S, Marçais J, Kolbe T, Huebner A, Frei RJ, Hampton T, Gu S, Buhman M, Sara Sayedi S, Ursache O, Chapin M, Henderson KD, Pinay G (2019) Human domination of the global water cycle absent from depictions and perceptions. Nature Geoscience 12:533–540. Doi: https://doi.org/10.1038/s41561-019-0374-y

Abu-Assal M, Craig W (1984) The zinc status of pregnant women. Nutrition Reports International 29:485–494.

Agriculture (2020) FoodData Central. https://fdc.nal.usda.gov/ndb/search.

Accessed on: Mar 25, 2022

Alexander P, Brown C, Arneth A, Dias C, Finnigan J, Moran D, Rounsevell MDA (2017) Could consumption of insects, cultured meat or imitation meat reduce global agricultural land use? Global Food Security 15:22–32. Doi: https://doi.org/10.1016/j.gfs.2017.04.001.

Alonso-Spilsbury M (2019) El bienestar animal: una propuesta ética al consumo de carne desde la medicina veterinaria y zootecnia. Académica Española, Madrid, Spain.

Alonso ME, González-Montaña JR, Lomillos JM (2020) Consumers' concerns and perceptions of farm animal welfare. Animals 10:385. Doi: https://doi.org/10.3390/ani10030385.

Alvaro C (2019) Lab-grown meat and veganism: a virtue-oriented perspective. Journal of Agricultural and Environmental Ethics 32:127–141. Doi: https://doi.org/10.1007/s10806-019-09759-2.

Alvaro C (2017) Ethical Veganism, virtue, and greatness of the soul. Journal of Agricultural and Environmental Ethics 30:765–781. Doi: https://doi.org/10.1007/s10806-017-9698-z.

Andersson R, Bergström S (1998.) Is maternal malnutrition associated with a low sex ratio at birth? Human Biology 70:1101–1106. PMID: 9825599.

Appleby MC (1999) What should we do about animal welfare? Wiley Blackwell, Malden, USA.

Appleby P, Roddam A, Allen N, Key T (2007) Comparative fracture risk in vegetarians and nonvegetarians in EPIC-Oxford. European Journal of Clinical Nutrition 61:1400–1406. Doi: https://doi.org/10.1038/sj.ejcn.1602659.

Azpitarte G (2020) Nietzsche y los animales. Dissertation, Universidad de Valencia, Spain.

Azrak L El, Charlebois S (2020) The impact of veganism/vegetarianism on animal welfare policy. Journal of Public Management Research 6:12. Doi: https://doi.org/10.5296/jpmr.v6i2.17750.

Barnard ND, Cohen J, Jenkins DJ, Turner-McGrievy G, Gloede L, Green A, Ferdowsian H (2009) A low-fat vegan diet and a conventional diabetes diet in the treatment of type 2 diabetes: a randomized, controlled, 74-wk clinical trial. The American Journal of Clinical Nutrition 89:1588S-1596S. Doi: https://doi.org/10.3945/ajcn.2009.26736H.

Barnard ND, Cohen J, Jenkins DJA, Turner-McGrievy G, Gloede L, Jaster B, Seidl K, Green AA, Talpers S (2006) A low-fat vegan diet improves glycemic control and cardiovascular risk factors in a randomized clinical trial in individuals with type 2 diabetes. Diabetes Care 29:1777–1783. Doi: https://doi.org/10.2337/dc06-0606.

Barquera S, Hernández-Barrera L, Trejo B, Shamah T, Campos-Nonato I, Rivera-Dommarco J (2020) Obesidad en México, prevalencia y tendencias en adultos. Salud Pública de México 62:682–692.

Barr S (2001) Women´s reproductive function. In: Sabate J (ed) Vegetarian Nutrition, 1st edn. CRC Press, Florida, USA, pp 221–249. Doi: 10.1201/9781420036831.ch10.

Barr SI, Chapman GE (2002) Perceptions and practices of self-defined current vegetarian, former vegetarian, and nonvegetarian women. Journal of the American Dietetic Association 102:354–360. Doi: https://doi.org/10.1016/S0002-8223(02)90083-0.

Bastian B, Loughnan S, Haslam N, Radke HRM (2012) Don't mind meat? the denial of mind to animals used for human consumption. Personality and Social Psychology Bulletin 38:247–256. Doi: https://doi.org/10.1177/0146167211424291.

Battini F, Agostini A, Tabaglio V, Amaducci S (2016) Environmental impacts of different dairy farming systems in the Po Valley. Journal of Cleaner Production 112:91–102. Doi: https://doi.org/10.1016/j.jclepro.2015.09.062.

Bazzano LA, He J, Ogden LG, Loria CM, Vupputuri S, Myers L, Whelton PK (2002) Fruit and vegetable intake and risk of cardiovascular disease in US adults: the first National Health and Nutrition Examination Survey Epidemiologic Follow-up Study. The American Journal of Clinical Nutrition 76:93–99. Doi: https://doi.org/10.1093/ajcn/76.1.93.

Beardsworth A, Keil T (1991) Health-related beliefs and dietary practices among vegetarians and vegans: a qualitative study. Health Education Journal 50:38–42. Doi: https://doi.org/10.1177/001789699105000111.

Bekele AE, Drabik D, Dries L, Heijman W (2021) Large-scale land investments, household displacement, and the effect on land degradation in semiarid agro-pastoral areas of Ethiopia. Land Degradation & Development 32:777–791. Doi: https://doi.org/10.1002/ldr.3756.

Bernal J (2019) Vegan pet diets is it possible to feed dogs and cats only with vegetables? Acta Scientific Nutritional Health 4:61–62. Doi: 10.31080/ASNH.2020.04.0575.

Bhat ZF, Kumar S, Fayaz H (2015) In vitro meat production: Challenges and benefits over conventional meat production. Journal of Integrative Agriculture 14:241–248. Doi: https://doi.org/10.1016/S2095-3119(14)60887-X.

Bloomer R, Gunnels T, Schriefer J (2015) Comparison of a Restricted and Unrestricted Vegan Diet Plan with a Restricted Omnivorous Diet Plan on Health-Specific Measures. Healthcare 3:544–555. Doi: https://doi.org/10.3390/healthcare3030544.

Bockman J (2019) Accomplishing the most good for animals. In: Dhont K, Hodson G (eds) Why we love and exploit animals. Routledge, London, England, p. 17.

Broom D (2021) Farm animal welfare: A key component of the sustainability of farming systems. Veterinarski Glasnik 00:1–7. Doi: https://doi.org/10.2298/VETGL210514007B.

Brown WY (2009) Nutritional and ethical issues regarding vegetarianism in the domestic do. Recent Advances in Animal Nutrition – Australia 17:137–143.

Bruckner DW (2020) The Vegan's Dilemma. Utilitas 32:350–367. Doi: https://doi.org/10.1017/S0953820820000060.

Bruckner TA, Helle S, Bolund E, Lummaa V (2015) Culled males, infant mortality and reproductive success in a pre-industrial Finnish population. In: Proceedings of the Royal Society B: Biological Sciences. p 20140835. Doi: https://doi.org/10.1098/rspb.2014.0835.

Bryant CJ (2019) We can't keep meating like this: attitudes towards vegetarian and vegan diets in the United Kingdom. Sustainability 11:6844. Doi: https://doi.org/10.3390/su11236844.

Buff PR, Carter RA, Bauer JE, Kersey JH (2014) Natural pet food: A review of natural diets and their impact on canine and feline physiology. Journal of Animal Science 92:3781–3791. Doi: https://doi.org/10.2527/jas.2014-7789.

Burr ML, Butland BK (1988) Heart disease in British vegetarians. The American Journal of Clinical Nutrition 48:830–832. Doi: https://doi.org/10.1093/ajcn/48.3.830.

Calpe-Berdiel L, Escolà-Gil JC, Blanco-Vaca F (2009) New insights into the molecular actions of plant sterols and stanols in cholesterol metabolism. Atherosclerosis 203:18–31. Doi: https://doi.org/10.1016/j.atherosclerosis.2008.06.026.

Carr M, Winslow G (20019 Meatless diet: A moral imperative? In: Sabate J (ed) Vegetarian Nutrition, 1st edn. CRC Press, Florida, USA, pp 221–249n

Case L, Daristotle L HM (2011) Protein requirements. In: Case L, Daristotle L, Hayek MG, Raasch M (eds) Canine and Feline Nutrition : A Resource for Companion Animal Professionals., 3rd edn. Mosby Elsevier, Missouri, USA, pp 89–106

Case L, Daristotle L, Hayek M (2011) Vitamins. In: Case L, Daristotle L, Hayek MG, Raasch M (eds) Canine and feline nutrition: a resource for companion animal professionals, 3rd edn. Mosby Elsevier, Missouri, USA, pp 27–36.

Case L, Daristotle L, Hayek MG, Raasch M (2010) Canine and feline nutrition: a resource for companion animal professionals, 3rd edn. Mosby Elsevier, Missouri, USA.

Chapagain AK, Hoekstra AY (20119 The blue, green and grey water footprint of rice from production and consumption perspectives. Ecological Economics 70:749–758. Doi: https://doi.org/10.1016/j.ecolecon.2010.11.012.

Chen C-W, Lin Y-L, Lin T-K, Lin C-T, Chen B-C, Lin C-L (2008) Total cardiovascular risk profile of Taiwanese vegetarians. European Journal of Clinical Nutrition 62:138–144. Doi: https://doi.org/10.1038/sj.ejcn.1602689.

Chen Y, She Y, Kaur R, Guo N, Zhang X, Zhang R, Gou X (2019) Is plant sterols a good strategy to lower cholesterol? Journal of Oleo Science 68:811–816. Doi: https://doi.org/10.5650/jos.ess19116.

Ciocchetti C (2012) Veganism and living well. Journal of Agricultural and Environmental Ethics 25:405–417. Doi: https://doi.org/10.1007/s10806-

011-9307-5.

Coetzee J (2002) Las Vidas de los Animales. Grijalbo Mondadori, Mexico City, Mexico

Cofnas N (2019) Is vegetarianism healthy for children? Critical Reviews in Food Science and Nutrition 59:2052–2060. Doi: https://doi.org/10.1080/10408398.2018.1437024.

Cramer H, Kessler CS, Sundberg T, Leach MJ, Schumann D, Adams J, Lauche R (2017) Characteristics of Americans choosing vegetarian and vegan diets for health reasons. Journal of Nutrition Education and Behavior 49:561-567.e1. Doi: https://doi.org/10.1016/j.jneb.2017.04.011.

Crowe FL, Appleby PN, Travis RC, Key TJ (2013) Risk of hospitalization or death from ischemic heart disease among British vegetarians and nonvegetarians: results from the EPIC-Oxford cohort study. The American Journal of Clinical Nutrition 97:597–603. Doi: https://doi.org/10.3945/ajcn.112.044073.

Davidson E (2012) Representative concentrations pathways and mitigations scenarios for nitrous oxide. Environmental Research Letters 7:024005. Doi: 10.1088/1748-9326/7/2/024005.

de Haas EN, Oliemans E, van Gerwen MAAM (2021) The need for an alternative to culling day-old male layer chicks: a survey on awareness, alternatives, and the willingness to pay for alternatives in a selected population of Dutch citizens. Frontiers in Veterinary Science 8:662197. Doi: https://doi.org/10.3389/fvets.2021.662197.

Demmelmair H, Øyen J, Pickert T, Rauh-Pfeiffer A, Stormark KM, Graff IE, Lie Ø, Kjellevold M, Koletzko B (2019) The effect of Atlantic salmon consumption on the cognitive performance of preschool children – A randomized controlled trial. Clinical Nutrition 38:2558–2568. Doi: https://doi.org/10.1016/j.clnu.2018.11.031.

Dewell A, Weidner G, Sumner MD, Chi CS, Ornish D (2008) A very-low-fat vegan diet increases intake of protective dietary factors and decreases intake of pathogenic dietary factors. Journal of the American Dietetic Association 108:347–356. Doi: https://doi.org/10.1016/j.jada.2007.10.044.

Dinu M, Abbate R, Gensini GF, Casini A, Sofi F (2017) Vegetarian, vegan diets and multiple health outcomes: A systematic review with meta-analysis of observational studies. Critical Reviews in Food Science and Nutrition 57:3640–3649. Doi: https://doi.org/10.1080/10408398.2016.1138447.

Djoussé L, Arnett DK, Coon H, Province MA, Moore LL, Ellison RC (2004) Fruit and vegetable consumption and LDL cholesterol: the National Heart, Lung, and Blood Institute Family Heart Study. The American Journal of Clinical Nutrition 79:213–217. Doi: https://doi.org/10.1093/ajcn/79.2.213.

Dodd SAS, Cave NJ, Adolphe JL, Shoveller AK, Verbrugghe A (2019) Plant-based (vegan) diets for pets: A survey of pet owner attitudes and feeding practices. PLOS ONE 14:e0210806. Doi: https://doi.org/10.1371/journal.pone.0210806

Dodd SAS, Dewey C, Khosa D, Verbrugghe A (2021) A cross-sectional study of owner-reported health in Canadian and American cats fed meat- and plant-based diets. BMC Veterinary Research 17:53. Doi: https://doi.org/10.1186/s12917-021-02754-8.

Domínguez-Oliva A, Mota-Rojas D, Semendric I, Whittaker AL (2023) The impact of vegan diets on indicators of health in dogs and cats: a systematic review. Veterinary Sciences 10:52. Doi: https://doi.org/10.3390/vetsci10010052.

Economou V, Gousia P (2015) Agriculture and food animals as a source of antimicrobial-resistant bacteria. Infection and Drug Resistance 8:49. Doi: https://doi.org/10.2147/IDR.S55778.

European Food Safety Authority (EFSA) (2014a) Scientific Opinion on the welfare risks related to the farming of sheep for wool, meat and milk production. EFSA Journal 12:1–128. Doi: 10.2903/j.efsa.2014.3933.

European Food Safety Authority (EFSA) (2011) Scientific opinion concerning the welfare of animals during transport. EFSA Journal 9:1966. Doi: 10.2903/j.efsa.2011.1966.

European Food Safety Authority (EFSA) (2012a) Scientific Opinion on the use of animal-based measures to assess welfare of dairy cows. EFSA Journal 10:2554. Doi: 10.2903/j.efsa.2012.2767.

European Food Safety Authority (EFSA) (2014b) Scientific Opinion concerning a Multifactorial approach on the use of animal and non-animal-based measures to assess the welfare of pigs. EFSA Journal 12:3702. Doi: 10.2903/j.efsa.2014.3702.

European Food Safety Authority (EFSA) (2012b) Statement on the use of animal-based measures to assess the welfare of animals. EFSA Journal 10:2767. Doi: 10.2903/j.efsa.2012.2554.

Food and Agriculture Organization (2012) El Estado Mundial de la Agricultura y la Alimentación. FAO, Rome, Italy.

Ferdous M, Arefin M, Rahman M, Ripon M, Rashid M, Sultana M, Hossain M, Ahammad M, Rafiq K (2019) Beneficial effects of probiotic and phytobiotic as growth promoter alternative to antibiotic for safe broiler production. Journal of Advanced Veterinary and Animal Research 6:409. Doi: http://doi.org/10.5455/javar.2019.f361.

Fessler DM., Arguello AP, Mekdara JM, Macias R (2003) Disgust sensitivity and meat consumption: a test of an emotivist account of moral vegetarianism. Appetite 41:31–41. Doi: 10.1016/S0195-6663(03)00037-0.

Fiestas-Flores J, Pyhälä A (20189 Dietary motivations and challenges among animal rights advocates in Spain. Society & Animals 26:402–425. Doi: 10.1163/15685306-12341484.

Francione GL (2009) Animals as persons: essays on the abolition of animal exploitation. Columbia University Press, New York, USA.

Fraser D (2008) Toward a global perspective on farm animal welfare. Applied Animal Behaviour Science 113:330–339. Doi: https://doi.org/10.1016/j.applanim.2008.01.011.

Fraser GE (1999) Associations between diet and cancer, ischemic heart disease, and all-cause mortality in non-Hispanic white California Seventh-day Adventists. The American Journal of Clinical Nutrition 70:532s-538s. Doi: https://doi.org/10.1093/ajcn/70.3.532s.

Freeman M (2000) Omega-3 fatty acids in psychiatry: a review. Annales of Clinic Psychiatry 12:159–65. Doi: https://doi.org/10.1023/A:1009069002816.

Fukuda M, Fukuda K, Shimizu T, Moller H (1998) Decline in sex ratio at birth after Kobe earthquake. Human Reproduction 13:2321–2322. Doi: https://doi.org/10.1093/humrep/13.8.2321.

Fun BNF (2021) Protein. https://www.nutrition.org.uk/healthy-sustainable-diets/protein/?level=Consumer Accessed on: Mar 5, 2022

Granados E (2018) La India, un país de vegetarianos por religión y necesidad.

https://www.lavanguardia.com/vida/20180930/452098251154/la-india-un-pais-de-vegetarianos-por-religion-y-necesidad.html. Accessed on: Mar 5, 2022.

Grandin T (2002) Animals are not things: A view on animal welfare based on neurological complexity. https://www.grandin.com/welfare/animals.are.not.things.html. Accessed on: Mar 5, 2022

Gruzalski B (1989) The case against raising and killing animals for food. In: Regan T, Singer P (eds) Animal rights and human obligations, 2nd edn. Prentice Hall, New Jersey, USA, pp 185–188.

Haapala EA, Eloranta A-M, Venäläinen T, Schwab U, Lindi V, Lakka TA (2015) Associations of diet quality with cognition in children – the physical activity and nutrition in children study. British Journal of Nutrition 114:1080–1087. Doi: https://doi.org/10.1017/S0007114515001634.

Hallström E, Carlsson-Kanyama A, Börjesson P (2015) Environmental impact of dietary change: a systematic review. Journal of Cleaner Production 91:1–11. Doi: https://doi.org/10.1016/j.jclepro.2014.12.008.

Hawkes K, O'Connell J, Blurton-Jones N (2018) Hunter-gatherer studies and human evolution: A very selective review. American Journal of Physics and Anthropology 165:777–800. Doi: https://doi.org/10.1002/ajpa.23403.

Hedenus F, Wirsenius S, Johansson DJA (2014) The importance of reduced meat and dairy consumption for meeting stringent climate change targets. Climatic Change 124:79–91. Doi: https://doi.org/10.1007/s10584-014-1104-5.

Herrmann W, Geisel J (2002) Vegetarian lifestyle and monitoring of vitamin B-12 status. Clinica Chimica Acta 326:47–59. Doi: https://doi.org/10.1016/S0009-8981(02)00307-8.

Herrmann W, Schorr H, Purschwitz K, Rassoul F, Richter V (2001) Total homocysteine, vitamin B(12), and total antioxidant status in vegetarians. Clinical Chemistry 47:1094–101. Doi: https://doi.org/10.1093/clinchem/47.6.1094.

Hines DM (2010) Vegetarians and Vegans in Kentucky. Dissertation, University of Kentucky.

Hoekstra A, Chapagain A (2007) Globalization of water: Sharing the planet's freshwater resources. Blackwell Publishing, Oxford, UK.

Hoekstra AY, Chapagain AK (2006) Water footprints of nations: Water use by people as a function of their consumption pattern. Water Resources Management 21:35–48. Doi: https://doi.org/10.1007/s11269-006-9039-x.

Hopkins J (20199 Protein content of common foods. https://www.hopkinsmedicine.org/bariatrics/_documents/nutrition_protein_content_common_foods.pdf. Accessed on: Mar 13, 2022.

Houwer J, Bruycker E (2007) Implicit attitudes towards meat and vegetables in vegetarians and nonvegetarians. International Journal of Psychology 42:158–165. Doi: https://doi.org/10.1080/00207590601067060.

Huang Y-W, Jian Z-H, Chang H-C, Nfor ON, Ko P-C, Lung C-C, Lin L-Y, Ho C-C, Chiang Y-C, Liaw Y-P (2014) Vegan diet and blood lipid profiles: a cross-sectional study of pre and postmenopausal women. BMC Women's Health 14:55. Doi: https://doi.org/10.1186/1472-6874-14-55.

Hudson P, Buckley R (2000) Vegetarian diets: Are they good for pregnant women and their babies? Practicing Midwife 3:22–23. Doi: https://doi.org/10.1093/ije/dyaa200.

Hung C-J, Huang P-C, Lu S-C, Li Y-H, Huang H-B, Lin B-F, Chang S-J, Chou H-F (2002) Plasma homocysteine levels in Taiwanese vegetarians are higher than those of omnivores. The Journal of Nutrition 132:152–158. Doi: https://doi.org/10.1093/jn/132.2.152.

Hunt MW (2019) Veganism and children: physical and social well-being. Journal of Agricultural and Environmental Ethics 32:269–291. Doi: https://doi.org/10.1007/s10806-019-09773-4.

Iguacel I, Miguel-Berges ML, Gómez-Bruton A, Moreno LA, Julián C (2019) Veganism, vegetarianism, bone mineral density, and fracture risk: a systematic review and meta-analysis. Nutrition Reviews 77:1–18. Doi: https://doi.org/10.1093/nutrit/nuy045.

Ismail I, Hwang Y-H, Joo S-T (2020) Meat analog as future food: a review. Journal of Animal Science and Technology 62:111–120. Doi: https://doi.org/10.5187/jast.2020.62.2.111.

Jabs J, Devine CM, Sobal J (1998) Model of the process of adopting vegetarian diets: health vegetarians and ethical vegetarians. Journal of Nutrition Education 30:196–202. Doi: https://doi.org/10.1016/S0022-3182(98)70319-X.

Jacboi F, Wittchen H-U, Hölting C, Höfler M, Pfister H, Müller N, Lieb R (2004) Prevalence, co-morbidity and correlates of mental disorders in the general population: results from the German Health Interview and Examination Survey (GHS). Psychological Medicine 34:597–611. Doi: https://doi.org/10.1017/S0033291703001399.

Jeswani HK, Azapagic A (2011) Water footprint: methodologies and a case study for assessing the impacts of water use. Journal of Cleaner Production 19:1288–1299. Doi: https://doi.org/10.1016/j.jclepro.2011.04.003.

Judge M, Wilson MS (2015) Vegetarian Utopias: Visions of dietary patterns in future societies and support for social change. Futures 71:57–69. Doi: https://doi.org/10.1016/j.futures.2015.07.005.

Kanakubo K, Fascetti AJ, Larsen JA (2015) Assessment of protein and amino acid concentrations and labeling adequacy of commercial vegetarian diets formulated for dogs and cats. Journal of the American Veterinary Medical Association 247:385–392. Doi: https://doi.org/10.2460/javma.247.4.385.

Kanianska R (2016) Agriculture and Its Impact on Land-Use, Environment, and Ecosystem Services. In: Almused A (ed) Landscape Ecology - The Influences of Land Use and Anthropogenic Impacts of Landscape Creation. InTech, Rijeka, Croatia, pp 3–6.

Kessler CS, Holler S, Joy S, Dhruva A, Michalsen A, Dobos G, Cramer H (2016) Personality profiles, values and empathy: differences between lacto-ovo-vegetarians and vegans. Complementary Medicine Research 23:95–102. Doi: https://doi.org/10.1159/000445369.

Key TJ, Appleby PN, Spencer EA, Travis RC, Allen NE, Thorogood M, Mann JI (2009) Cancer incidence in British vegetarians. British Journal of Cancer 101:192–197. Doi: https://doi.org/10.1038/sj.bjc.6605098.

Key TJ, Fraser GE, Thorogood M, Appleby PN, Beral V, Reeves G, Burr ML, Chang-Claude J, Frentzel-Beyme R, Kuzma JW, Mann J, McPherson K (1999) Mortality in vegetarians and nonvegetarians: detailed findings from a collaborative analysis of 5 prospective studies. The American Journal of Clinical Nutrition 70:516s-524s. Doi: 10.1093/ajcn/70.3.516s.

Kiemer L (2019) Vegan diet and its effect on the dog's health. Dissertation, Lithuanian University of Health Sciences Veterinary Academy.

Knight A, Leitsberger M (2016) Vegetarian versus meat-based diets for companion animals. Animals 6:57. Doi: https://doi.org/10.3390/ani6090057.

Koech R, Langat P (2018) Improving irrigation water use efficiency: a review of advances, challenges and opportunities in the Australian context. Water 10:1771. Doi: https://doi.org/10.3390/w10121771.

Kook PH, Melliger RH, Hersberger M (2020) Efficacy of intramuscular hydroxocobalamin supplementation in cats with cobalamin deficiency and gastrointestinal disease. Journal of Veterinary Internal Medicine 34:1872–1878. Doi: https://doi.org/10.1111/jvim.15865.

Krajčovičová-Kudláčková M, Bučková K, Klimeš I, Šeboková E (2003) Iodine deficiency in vegetarians and vegans. Annals of Nutrition and Metabolism 47:183–185. Doi: https://doi.org/10.1159/000070483.

Larsen JA, Fascetti AJ (2020) The role of taurine in cardiac health in dogs and cats. Advances in Small Animal Care 1:227–238. Doi: https://doi.org/10.1016/j.yasa.2020.07.015.

Le L, Sabaté J (2014) Beyond meatless, the health effects of vegan diets: findings from the Adventist cohorts. Nutrients 6:2131–2147. Doi: https://doi.org/10.3390/nu6062131.

Lea E, Worsley A (2001) Influences on meat consumption in Australia. Appetite 36:127–136. Doi: https://doi.org/10.1006/appe.2000.0386.

Lehner A, Staub K, Aldakak L, Eppenberger P, Rühli F, Martin RD, Bender N (2020) Fish consumption is associated with school performance in children in a non-linear way. Evolution, Medicine, and Public Health 2020:2–11. Doi: https://doi.org/10.1093/emph/eoz038.

Li D (2011) Chemistry behind Vegetarianism. Journal of Agricultural and Food Chemistry 59:777–784. Doi: https://doi.org/10.1021/jf103846u.

Lightowler H, Davies G, Trevan M (1996) Iodine in the diet: Perspectives for vegans. Journal of the Royal Society of Health 116:14–20. Doi: https://doi.org/10.1177/146642409611600.

Lopez PD, Cativo EH, Atlas SA, Rosendorff C (2019) The effect of vegan diets on blood pressure in adults: a meta-analysis of randomized controlled trials. The American Journal of Medicine 132:875-883.e7. Doi: https://doi.org/10.1016/j.amjmed.2019.01.044.

Lürzel S, Münsch C, Windschnurer I, Futschik A, Palme R, Waiblinger S (2015) The influence of gentle interactions on avoidance distance towards humans, weight gain and physiological parameters in group-housed dairy calves. Applied Animal Behaviour Science 172:9–16. Doi: https://doi.org/10.1016/j.applanim.2015.09.004.

Maclatchy D, Vanderkraak GJ (1995) The phytoestrogen β-sitosterol alters the reproductive endocrine status of goldfish. Toxicology and Applied Pharmacology 134:305–312. Doi: https://doi.org/10.1006/taap.1995.1196.

Maldonado S, Ramírez S, García S, Ceballos R, Méndez B (2012) Colesterol: Función biológica e implicaciones médicas. Revista Mexicana de Ciencias Farmacéuticas 43:7–22.

Martinelli D, Berkmanienė A (2018) The politics and the demographics of veganism: notes for a critical analysis. International Journal for the Semiotics of Law - Revue Internationale de Sémiotique Juridique 31:501–530. Doi: https://doi.org/10.1007/s11196-018-9543-3.

McFarland T (2020) Vegan dry skin: possible causes and cures. https://www.iamgoingvegan.com/vegan-dry-skin/. Accessed on: May 5, 2022.

McInerney JP (2004) Animal Welfare, Economics and Policy. https://webarchive.nationalarchives.gov.uk/ukgwa/20110318142209/http://www.defra.gov.uk/evidence/economics/foodfarm/reports/documents/a

nimalwelfare.pdf. Accessed on: Mar 5, 2022.

McLean RR, Jacques PF, Selhub J, Fredman L, Tucker KL, Samelson EJ, Kiel DP, Cupples LA, Hannan MT (2008) Plasma B vitamins, homocysteine, and their relation with bone loss and hip fracture in elderly men and women. The Journal of Clinical Endocrinology & Metabolism 93:2206–2212. Doi: https://doi.org/10.1210/jc.2007-2710.

McLennan K (2018) Why pain is still a welfare issue for farm animals, and how facial expression could be the answer. Agriculture 8:127. Doi: https://doi.org/10.3390/agriculture8080127.

McNulty H, Pentieva K, Hoey L, Ward M (2008) Homocysteine, B-vitamins and CVD. In: Proceedings of the Nutrition Society. pp 232–237.

Melina V, Craig W, Levin S (2016) Position of the academy of nutrition and dietetics: vegetarian diets. Journal of the Academy of Nutrition and Dietetics 116:1970–1980. Doi: https://doi.org/10.1016/j.jand.2016.09.025.

Mellen PB, Walsh TF, Herrington DM (2008) Whole grain intake and cardiovascular disease: A meta-analysis. Nutrition, Metabolism and Cardiovascular Diseases 18:283–290. Doi: https://doi.org/10.1016/j.numecd.2006.12.008.

Messina V, Reed Mangels AN (2001) Considerations in planning vegan diets. Journal of the American Dietetic Association 101:661–669. Doi: https://doi.org/10.1016/S0002-8223(01)00167-5.

Messina M (1996) The vegetarian way: total health for you and your family, 1st edn. Crown Trade Paperbacks, New York, USA.

Micha R, Wallace SK, Mozaffarian D (2010) Red and processed meat consumption and risk of incident coronary heart disease, stroke, and diabetes mellitus. Circulation 121:2271–2283. Doi: 10.1161/CIRCULATIONAHA.109.924977.

Michalak J, Zhang X, Jacobi F (2012) Vegetarian diet and mental disorders: results from a representative community survey. International Journal of Behavioral Nutrition and Physical Activity 9:67. Doi: https://doi.org/10.1186/1479-5868-9-67.

Mongabay L, Paz-Cardona A (2019) Los pecados de la palma aceitera en latinoamérica. El Espectador. https://blogs.elespectador.com/medio-ambiente/mongabay-latam/especial-mongabay-latam-los-pecados-la-palma-aceitera-latinoamerica. Accessed on: Mar 13, 2022.

Morand S (2020) Emerging diseases, livestock expansion and biodiversity loss are positively related at global scale. Biological Conservation 248:108707. Doi: https://doi.org/10.1016/j.biocon.2020.108707.

Mota-Rojas D, Orihuela A, Strappini-Asteggiano A, Cajiao-Pachón M, Agüera-Buendía E, Mora-Medina P, Ghezzi M, Alonso-Spilsbury M (2018) Teaching animal welfare in veterinary schools in Latin America. International Journal of Veterinary Science and Medicine 6:131–140. Doi: https://doi.org/10.1016/j.ijvsm.2018.07.003.

Mota-Rojas D, Becerril-Herrera M, Alonso-Spilsbury M, Flores-Peinado S, Ramírez-Necoechea R, Ramírez-Telles JA, Mora-Medina P, Pérez M, Molina E, Soní E, Trujillo-Ortega ME (2012) Effects of long distance transportation and CO2 stunning on critical blood values in pigs. Meat Science 90:893–898. Doi: https://doi.org/10.1016/j.meatsci.2011.11.027.

Mota-Rojas D, Broom D. DM, Orihuela A, Velarde A, Napolitano F, Alonso-Spilsbury M (2020) Effects of human-animal relationship on animal productivity and welfare. Journal of Animal Behaviour and Biometeorology 8:196–205. Doi: http://dx.doi.org/10.31893/jabb.20026.

Mota-Rojas D, Ghezzi MD, Napolitano F, Rosmini MR, Guerrero-Legarreta I, Martínez-Burnes J, Lezama-García K, Miranda-Cortés A, Vega LT de la, Mora-Medina P, Hernández-Ávalos I (2021a) Quality of death in the river buffalo (Bubalus bubalis). Journal of Animal Behaviour and Biometeorology 9:1–10. Doi: http://dx.doi.org/10.31893/jabb.21015.

Mota-Rojas D, Mariti C, Zdeinert A, Riggio G, Mora-Medina P, del Mar Reyes A, Gazzano A, Domínguez-Oliva A, Lezama-García K, José-Pérez N, Hernández-Ávalos I (2021b) Anthropomorphism and Its Adverse Effects on the Distress and Welfare of Companion Animals. Animals 11:3263. Doi: https://doi.org/10.3390/ani11113263.

Mota-Rojas D, Napolitano F, Strappini A, Orihuela A, Ghezzi MD, Hernández-Ávalos I, Mora-Medina P, Whittaker A (2021c) Pain at the slaughterhouse in ruminants with a focus on the neurobiology of sensitisation. Animals 11:1085. Doi: https://doi.org/10.3390/ani11041085.

Mota-Rojas D, Strappini A, Whittaker AL, Ghezzi M, Gonçalves Titto C, Calderón-Maldonado N, Mora-Medina P, Domínguez-Oliva A, Gómez-Prado J, Her-nández-Ávalos I, José-Pérez N, Casas-Alvarado A, Orihuela A (2023) Controversial topics in animal welfare in Latin America: A focus on the legislation of human-companion animal relationship and animals used for recreational practices. Animals 13: In press.

Mubako ST (2018) Blue, green, and grey water quantification approaches: a bibliometric and literature review. Journal of Contemporary Water Research & Education 165:4–19. Doi: https://doi.org/10.1111/j.1936-704X.2018.03289.x.

Muhammad J, Khan S, Su JQ, Hesham AE-L, Ditta A, Nawab J, Ali A (2020) Antibiotics in poultry manure and their associated health issues: a systematic review. Journal of Soils and Sediments 20:486–497. Doi: https://doi.org/10.1007/s11368-019-02360-0.

Naigamwalla DZ, Webb JA, Giger U (2012) Iron deficiency anemia. The Canadian veterinary Journal 53:250–256. PMID: 22942439.

Nascimento FM, Dias NK, Mendes G (2018) Nutritional status and level of physical activity of vegetarians and omnivorous of the federal disctrict. Revista Brasileira De Nutrição Esportiva 12:740–746.

Neo H (2016) Ethical consumption, meaningful substitution and the challenges of vegetarianism advocacy. The Geographical Journal 182:201–212. Doi: https://www.jstor.org/stable/43868700.

Network Water Footprint (2022). What is a water footprint? https://waterfootprint.org/en/water-footprint/what-is-water-footprint/. Accessed on: Mar 25, 2022.

Neufingerl N, Eilander A (2021) Nutrient intake and status in adults consuming plant-based diets compared to meat-eaters: A systematic review. Nutrients 14:29. Doi: https://doi.org/10.3390/nu14010029.

Neumann CG, Murphy SP, Gewa C, Grillenberger M, Bwibo NO (2007) Meat supplementation improves growth, cognitive, and behavioral outcomes in Kenyan children. The Journal of Nutrition 137:1119–1123. Doi: https://doi.org/10.1093/jn/137.4.1119.

Nielsen SS, Alvarez J, Bicout DJ, Calistri P, Depner K, Drewe JA, Garin-Bastuji B, Gonzales Rojas JL, Schmidt CG, Michel V, Miranda Chueca MÁ, Roberts HC, Sihvonen LH, Spoolder H, Stahl K, Velarde A, Viltrop A, Candiani D, Van der Stede Y, Winckler C (2020) Welfare of cattle at slaughter. EFSA Journal 18:e06275. Doi: https://doi.org/10.2903/j.efsa.2020.6275.

Norat T, Bingham S, Ferrari P, Slimani N, Jenab M, Mazuir M, Overvad K, Olsen A, Tjønneland A, Clavel F, Boutron-Ruault M-C, Kesse E, Boeing H, Bergmann MM, Nieters A, Linseisen J, Trichopoulou A, Trichopoulos D, Tountas Y, Berrino F, Palli D, Panico S, Tumino R, Vineis P, Bueno-de-Mesquita HB, Peeters PHM, Engeset D, Lund E, Skeie G, Ardanaz E, González C, Navarro C, Quirós JR, Sanchez M-J, Berglund G, Mattisson I, Hallmans G, Palmqvist R, Day NE, Khaw K-T, Key TJ, San Joaquin M, Hémon B, Saracci R, Kaaks R, Riboli E (2005) Meat, fish, and colorectal cancer risk: the european prospective investigation into cancer and nutrition. JNCI: Journal of the National Cancer Institute 97:906–916. Doi: https://doi.org/10.1093/jnci/dji164.

North K, Golding J (2000) A maternal vegetarian diet in pregnancy is associated with hypospadias. BJU International 85:107–113. Doi: https://doi.org/10.1046/j.1464-410x.2000.00436.x.

Olfert MD, Wattick RA (2018) Vegetarian diets and the risk of diabetes. Current Diabetes Reports 18:101. Doi: 10.1007/s11892-018-1070-9.

Orihuela A, Mota-Rojas D, Velarde A, Strappini-Asteggiano A, Vega LT de la, Borderas-Tordesillas F, Alonso-Spilsbury M, Thielo de la Vega, L. Borderas-Tordesillas F, Alonso-Spilsbury M (2018) Environmental enrichment to improve behaviour in farm animals. CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources 13:1–25. Doi: 10.1079/PAVSNNR201813059.

Ostrowski B, Malinowska A, Budzyńska A, Nowakowska-Duława E, Hartleb M (2018) Effects of vegetarian diet on gastrointestinal symptoms. Pediatria i Medycyna Rodzinna 14:402–406. Doi: 10.15557/PiMR.2018.0052.

Patisaul HB, Jefferson W (2010) The pros and cons of phytoestrogens. Frontiers in Neuroendocrinology 31:400–419. Doi: 10.1016/j.yfrne.2010.03.003.

Pawlak R, James PS, Raj S (2012) Understanding vitamin B12. American

Journal of Lifestyle Medicine 7:60–65. Doi: https://doi.org/10.1177/1559827612450688.

Perica MM, Delaš I (2011) Essential fatty acids and psychiatric disorders. Nutrition in Clinical Practice 26:409–425. Doi: https://doi.org/10.1177/0884533611411306.

Petti A, Palmieri B, Vadalà M, Laurino C (2017) Vegetarianism and veganism: not only benefits but also gaps. A review. Progress in Nutrition 19:229–242. Doi: https://doi.org/10.23751/pn.v19i3.5229.

Phillips F (2005) Vegetarian nutrition. Nutrition Bulletin 30:132–167.

Piazza J (2019) Why people love animals yet continue to eat them. In: Dhont K, Hodson G (eds) Why we love and exploit animals. Routledge, London, England, pp 121–136.

Pickett S (2021) Veganism, moral motivation and false consciousness. Journal of Agricultural and Environmental Ethics 34:15. Doi: https://doi.org/10.1007/s10806-021-09857-0.

Pribis P, Pencak RC, Grajales T (2010) Beliefs and attitudes toward vegetarian lifestyle across generations. Nutrients 2:523–531. Doi: https://doi.org/10.3390/nu2050523.

Prieto A (2009) Veganismo, una filosofía de vida. https://www.animanaturalis.org/n/veganismo-una-filosofia-de-vida. Accessed on: May 5, 2022.

Qasimi MI, Mohibbi H, Nagaoka K, Watanabe G (2018) Effects of Phytosterols as food additives on adrenal and reproductive endocrine function during sexual maturation in male japanese quail (*Coturnix coturnix japonica*). The Journal of Poultry Science 55:155–161. Doi: https://doi.org/10.2141/jpsa.0170022

Reisinger A, Clark H (2018) How much do direct livestock emissions actually contribute to global warming? Global Change Biology 24:1749–1761. Doi: https://doi.org/10.1111/gcb.13975.

Rochais C, Henry S, Sankey C, Nassur F, Góracka-Bruzda A, Hausberger M (2014) Visual attention, an indicator of human-animal relationships? A study of domestic horses (Equus caballus). Frontiers in Psychology 5:108. Doi: https://doi.org/10.3389/fpsyg.2014.00108.

Rojo V (2021) Agua ¿Cuánta se Necesita Para Producir Alimentos? https://gastronomadas.com.mx/agua-cuanta-se-necesita-para-producir-alimentos/. Accesed on: March 5, 2022.

Rose L, Marshall F (1996) Meat eating, homonid sociality, and home bases revisited. Current Anthropology 37:307–338. Doi: https://www.jstor.org/stable/2744352.

Rosenfeld DL (2019) A comparison of dietarian identity profiles between vegetarians and vegans. Food Quality and Preference 72:40–44. Doi: https://doi.org/10.1016/j.foodqual.2018.09.008.

Rost S, Gerten D, Bondeau A, Lucht W, Rohwer J, Schaphoff S (2008) Agricultural green and blue water consumption and its influence on the global water system. Water Resources Research 44:W09405.

Rothgerber H (2014) Carnivorous cats, vegetarian dogs, and the resolution of the vegetarian's dilemma. Anthrozoös 27:485–498. Doi: https://doi.org/10.2752/089279314X14072268687844.

Rothgerber H (2015) Underlying differences between conscientious omnivores and vegetarians in the evaluation of meat and animals. Appetite 87:251–258. Doi: https://doi.org/10.1016/j.appet.2014.12.206.

Rothgerberg H (2017) Attitudes toward meat and plants in vegetarians. In: Mariotti F (ed) Vegetarian and Plant Based Diets in Health and Disease Prevention, 1st edn. Academic Press, London, UK, pp 11–35.

Ruby MB (2012) Vegetarianism. A blossoming field of study. Appetite 58:141–150. Doi: https://doi.org/10.1016/j.appet.2011.09.019.

Ruiz Carreras M (2019). La política sexual de la carne. Una teoría crítica feminista vegetariana. Madrid: Ochodoscuatro Ediciones. Papeles del CEIC.

Salt H (1914) The humanities of diet. The Vegan Society, Manchester, UK.

Sandoe P, Nielsen BL, Christensen LG, Sorensen P. 1999. Staying good while playing god--the ethics of breeding farm animals. Animal welfare. 8:313–28. Doi: https://doi.org/10.1017/S0962728600021953.

Saunders AV, Davis BC, Garg ML (2013) Omega-3 polyunsaturated fatty acids and vegetarian diets. Medical Journal of Australia 199:s22–s6. Doi: 10.5694/mja11.11507.

Saxmose Nielsen S, Alvarez J, Bicout DJ, Calistri P, Depner K, Drewe JA, Garin-Bastuji B, Gonzales Rojas JL, Gortázar Schmidt C, Michel V, Miranda Chueca MÁ, Roberts HC, Sihvonen LH, Stahl K, Velarde Calvo A, Viltrop A, Winckler C, Candiani D, Fabris C, Mosbach-Schulz O, Van der Stede Y, Spoolder H (2020) Scientific opinion concerning the killing of rabbits for purposes other than slaughter. EFSA Journal 18:e05943. Doi: 10.2903/j.efsa.2020.5943.

Schneidere F, Tarawali S (2021) Sustainable development goals and livestock systems. Revue Scientifique et Technique 40:1–19. Doi: https://doi.org/10.20506/rst.40.2.3247.

Schuchardt JP, Huss M, Stauss-Grabo M, Hahn A (2010) Significance of long-chain polyunsaturated fatty acids (PUFAs) for the development and behaviour of children. European Journal of Pediatrics 169:149–164. Doi: https://doi.org/10.1007/s00431-009-1035-8.

Sean D, Fascetti AJ (2012) Basic nutrition overview. In: Sean D, Fascetti AJ (eds) Applied Veterinary Clinical Nutrition. John Wiley & Sons, Iowa, USA, pp 9–22.

Sebastiani G, Herranz Barbero A, Borrás-Novell C, Alsina Casanova M, Aldecoa-Bilbao V, Andreu-Fernández V, Pascual Tutusaus M, Ferrero Martínez S, Gómez Roig M, García-Algar O (2019) The effects of vegetarian and vegan diet during pregnancy on the health of mothers and offspring. Nutrients 11:557. Doi: https://doi.org/10.3390/nu11030557.

Segovia-Siapco G, Sabaté J (2019) Health and sustainability outcomes of vegetarian dietary patterns: a revisit of the EPIC-Oxford and the Adventist Health Study-2 cohorts. European Journal of Clinical Nutrition 72:60–70. Doi: https://doi.org/10.1038/s41430-018-0310-z.

Semp P-G (2014) Vegan nutrition of dogs and cats. Dissertation, Veterinärmedizinische Universität Wien.

Shafiq N, Singh M, Kaur S, Khosla P, Malhotra S (2010) Dietary treatment for familial hypercholesterolaemia. In: Shafiq N (ed) Cochrane Database of Systematic Reviews. John Wiley & Sons, Ltd, Chichester, UK, pp 19-18.

Shinwell ED, Gorodischer R (1982) Totally vegetarian diets and infant nutrition. Pediatrics 70:582–586. PMID: 6812012.

Singh K, Gupta R (2016) Antifertility activity of β-sitosterol isolated from Barleria Prionitis (L.) roots in male albino rats. International Journal of Pharmacology and Pharmaceutical Science 8:88–96

Sinha R, Cross AJ, Graubard BI, Leitzmann MF, Schatzkin A (2009) Meat intake and mortality. Archives of Internal Medicine 169:562. Doi: 10.1001/archinternmed.2009.6.

Sintori A, Tzouramani I, Liontakis A (2019) Greenhouse gas emissions in dairy goat farming systems: abatement potential and cost. Animals 9:945. Doi: https://doi.org/10.3390/ani9110945.

Skaf L, Buonocore E, Dumontet S, Capone R, Franzese PP (2019) Food security and sustainable agriculture in Lebanon: An environmental accounting framework. Journal of Cleaner Production 209:1025–1032. Doi: https://doi.org/10.1016/j.jclepro.2018.10.301.

Slywitch E, Savalli C, Duarte ACG, Escrivão MAMS (2021) Iron deficiency in vegetarian and omnivorous individuals: analysis of 1340 individuals. Nutrients 13:2964. Doi: https://doi.org/10.3390/nu13092964.

Stabler SP, Allen RH (2004) Vitamin b12 deficiency as a worldwide problem. Annual Review of Nutrition 24:299–326. Doi: https://doi.org/10.1146/annurev.nutr.24.012003.132440.

Stephen SL (2021) Social rights and duties: addresses to ethical societies. Legarre Street Press, New York, USA.

Stringer LC, Fraser EDG, Harris D, Lyon C, Pereira L, Ward CFM, Simelton E (2020) Adaptation and development pathways for different types of farmers. Environmental Science & Policy 104:174–189. Doi: https://doi.org/10.1016/j.envsci.2019.10.007.

Tong TYN, Appleby PN, Bradbury KE, Perez-Cornago A, Travis RC, Clarke R, Key TJ (2019) Risks of ischaemic heart disease and stroke in meat eaters, fish eaters, and vegetarians over 18 years of follow-up: results from the prospective EPIC-Oxford study. BMJ 1:l4897. Doi: https://doi.org/10.1136/bmj.l4897.

Tonstad S, Stewart K, Oda K, Batech M, Herring RP, Fraser GE (2013) Vegetarian diets and incidence of diabetes in the Adventist Health Study-2.

Nutrition, Metabolism and Cardiovascular Diseases 23:292–299. Doi: https://doi.org/10.1016/j.numecd.2011.07.004.

Tovar L (2011) Feminismo y veganismo. Available: http://filosofiavegana.blogspot.com/2011/12/feminismo-y-veganismo.html. Accessed on: May 6, 2022.

Tuncay G, Bulut M (2019) A bioethical approach: Vegan and vegetarian experiences. Progress in Nutrition 21:375–81. Doi: https://doi.org/10.23751/pn.v21i2.6885.

Ursin L (2016) The ethics of the meat paradox. Environmental Ethics 38:131–144.

Vance D (2000) Cholesterol in the year 2000. Biochimica et Biophysica Acta (BBA) - Molecular and Cell Biology of Lipids 1529:1–8. Doi: 10.5840/enviroethics201638212.

Vang A, Singh PN, Lee JW, Haddad EH, Brinegar CH (2008) Meats, processed meats, obesity, weight gain and occurrence of diabetes among adults: findings from adventist health studies. Annals of Nutrition and Metabolism 52:96–104. Doi: 10.1159/000121365.

Velasco I, Bath S, Rayman M (2018) Iodine as essential nutrient during the first 1000 days of life. Nutrients 10:290. Doi: https://doi.org/10.3390/nu10030290.

Veronese N, Reginster J-Y (2019) The effects of calorie restriction, intermittent fasting and vegetarian diets on bone health. Aging Clinical and Experimental Research 31:753–758. Doi: https://doi.org/10.1007/s40520-019-01174-x.

Wakefield LA, Shofer FS, Michel KE (2006) Evaluation of cats fed vegetarian diets and attitudes of their caregivers. Journal of the American Veterinary Medical Association 229:70–73. Doi: https://doi.org/10.2460/javma.229.1.70.

Walsh B (2013) The triple whopper environmental impact of global meat production. https://science.time.com/2013/12/16/the-triple-whopper-environmental-impact-of-global-meat-production/. Accessed on: Mar 12, 2022.

Warner RD (2019) Review: Analysis of the process and drivers for cellular meat production. Animal 13:3041–3058. Doi: https://doi.org/10.1017/S1751731119001897.

Watling CZ, Schmidt JA, Dunneram Y, Tong TYN, Kelly RK, Knuppel A, Travis RC, Key TJ, Perez-Cornago A (2022) Risk of cancer in regular and low meat-eaters, fish-eaters, and vegetarians: a prospective analysis of UK Biobank participants. BMC Medicine 20:73. Doi: https://doi.org/10.1186/s12916-022-02256-w.

Weder S, Hoffmann M, Becker K, Alexy U, Keller M (2019) Energy, macronutrient intake, and anthropometrics of vegetarian, vegan, and omnivorous children (1–3 years) in Germany (VeChi Diet Study). Nutrients 11:832. Doi: https://doi.org/10.3390/nu11040832.

Wilson MS, Weatherall A, Butler C (2004) A rhetorical approach to discussions about health and vegetarianism. Journal of Health Psychology 9:567–581. Doi: https://doi.org/10.1177/1359105304044040.

Wolke D, Lereya ST (2015) Long-term effects of bullying. Archives of Disease in Childhood 100:879–885. Doi: http://dx.doi.org/10.1136/archdischild-2014-306667.

World Health Organization (2017) Animal welfare: an asset for livestock production. https://www.oie.int/app/uploads/2021/03/bull-2017-1-eng.pdf. Accessed on: Mar 29, 2022

World Health Organization (WHO) (2021) Food systems delivering better health. World Health Organization, Geneva, Switzerland

Wortinger A, Burns K (2015) Protein and Amino Acids. In: Wortinger A, Burns KM (eds) Nutrition and disease management for veterinary technicians and nurses, 2nd edn. Wiley Blackwell, New Jersey, USA, pp 1–272.

Wright N, Wilson L, Smith M, Duncan B, McHugh P (2017) The BROAD study: A randomised controlled trial using a whole food plant-based diet in the community for obesity, ischaemic heart disease or diabetes. Nutrition & Diabetes 7:e256–e256. Doi: https://doi.org/10.1038/nutd.2017.3.

Yokoyama Y, Levin SM, Barnard ND (2017) Association between plant-based diets and plasma lipids: a systematic review and meta-analysis. Nutrition Reviews 75:683–698. Doi: https://doi.org/10.1093/nutrit/nux030.

Young G, Conquer J (2005) Omega-3 fatty acids and neuropsychiatric disorders. Reproduction Nutrition Development 45:1–28. Doi: https://doi.org/10.1051/rnd:2005001.

Young VR, Pellett PL (1985) Wheat proteins in relation to protein requirements and availability of amino acids. The American Journal of Clinical Nutrition 41:1077–1090. Doi: https://doi.org/10.1093/ajcn/41.5.1077.

Young VR, Pellett PL (1994) Plant proteins in relation to human protein and amino acid nutrition. The American Journal of Clinical Nutrition 59:1203S-1212S. Doi: https://doi.org/10.1093/ajcn/59.5.1203S.

Zafalon RVA, Risolia LW, Vendramini THA, Ayres Rodrigues RB, Pedrinelli V, Teixeira FA, Rentas MF, Perini MP, Alvarenga IC, Brunetto MA (2020) Nutritional inadequacies in commercial vegan foods for dogs and cats. PLOS ONE 15:e0227046. Doi: https://doi.org/10.1371/journal.pone.0227046.

Zmora E (1979) Multiple nutritional deficiencies in infants from a strict vegetarian community. Archives of Pediatrics & Adolescent Medicine 133:141. Doi: 10.1001/archpedi.1979.02130020031005.

Zoran DL (2002) The carnivore connection to nutrition in cats. Journal of the American Veterinary Medical Association 221:1559–1567. Doi: https://doi.org/10.2460/javma.2002.221.1559.