Article title: Religious and Regulatory concerns of animal free meat and milk

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Religious and regulatory concerns

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Abstract

Advances in scientific research have fostered cutting edge technologies such as cultured meat and cow less milk as touted by the promoters receiving considerable attention in recent times. The perceived benefits seem promising since, gas emissions, water and land use and animal suffering are reduced considerably as claimed by the proponents. This article aims to provide an overview on the religious and regulatory perspectives of animal less meat and milk. The dietary laws of some major religions are discussed followed by global food regulation and role of codex in emerging technologies. Religious perspectives of Hindus, Christians and Muslims on culture meat has also been discussed in detail. The regulatory status of European Union and United States are presented. In conclusion, consumer acceptance remains the wild card in making any technology grow. However, Innovation and technological progress are very important to shape the future of agriculture and food security and can only be achieved through appropriate support from all stakeholders.

Key words: animal less meat, religion, regulation, codex, greenhouse gas emission

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31 **Introduction:**

32 Consumption of animal milk and meat has been practiced since Prehistoric
33 humans and even their ancestors ate some amount of meat (Garn and Leonard,
34 1989). Progressive technological developments resulted in domestication of
35 animals to produce milk and meat on a larger scale. Today, the Global meat
36 production has almost quadrupled from 78 million tons in 1963 to a total of 308
37 million tons per year (FAOSTAT, 2014). The consumption of livestock products
38 has been predicted to increase by 70% between 2010 and 2050 (Gerber *et al.*
39 2013). Similarly, current global milk production is around 876 million tons and the
40 figure expected to rise by 35 per cent by 2030.

41 While the production and demand continue to grow rapidly, large scale
42 production has serious implications on the environment. For instance, it causes
43 about one-fifth of global greenhouse gas emissions; a key land user and source
44 of water pollution by nutrient overabundance besides competing with biodiversity,
45 and promoting species extinctions (Eshel *et al.*, 2014).

46 Animal welfare concerns, sustainability and greenhouse gas emissions have
47 triggered public debate and discussion to minimize meat and dairy products in
48 western countries (Garnett, 2011; Krystallis *et al.*, 2012). The discussion revolves
49 around reduction of negative impact of the livestock sector by technological
50 measures, finding alternative protein substitute without undermining dietary
51 intake and food security (Stehfest *et al.*, 2013).

Religious and regulatory concerns

Advances in scientific research have fostered cutting edge technologies such as cultured meat & cow less milk as touted by the promoters receiving considerable attention in recent times. The technology applies animal skeletal muscle stem cells fed with calf serum and other growth medium to initiate multiplication and prompt them to develop into muscle cells over time. Upon differentiation into muscle cells, they were given simple nutrient sources, such as algae extracts in a bioreactor for large scale production (Lynch & Pierrehumbert, 2019).

In the case of cow less milk, genes associated with the production of casein and whey proteins from cow are added to yeast cells in a fermenter containing water and sugars to produce whey and casein. The yeast is then filtered from the mixture to which plant-based fats, sugars are then added to mimic cow's milk (Milburn, 2018).

The technologies seem promising since the energy consumption, gas emissions, water and land use estimates are reduced considerably when compared to conventional production (Stephens *et al.*, 2018). Although the mass production might face many challenges (Post, 2012), it is worthwhile to consider the theory behind such developments and evaluate its applicability in real time especially when food and environmental security is at stake. Given this background, this study attempts to address religious and regulatory concerns associated with animal free meat and milk. The article is structured to begin with an overview on religious dietary laws followed by global food regulation and religion and regulation – friend or foe for animal less meat & milk with concluding remarks.

75 ***Religious dietary laws - an overview***

76 Almost all religious practices have special dietary laws that rests on the
77 foundation of religious ideologies. Though the basic composition of food includes
78 carbohydrates, proteins, fats, minerals and water and there exists many edible
79 items, food habits are generally based on the doctrines of respective religion.

80 In Sanatana dharma (Hinduism), it is believed that food is responsible for
81 physical birth and development of our bodies. Almost all the Hindu scriptures
82 state that the temperament of an individual is determined by the type of food
83 consumed. Accordingly, the concept of *triguna* (three qualities) namely sattvic,
84 rajasic and tamsic determine the human traits and states. The food from plant
85 origin and milk are included in sattvic (light and pure) type which is believed to
86 produce calmness and serenity of mind while rajasic (energetic) type includes
87 spicy, sour and bitter foods. The tamsic (dull) type include animal meat and
88 alcohol that is thought to be responsible for the degeneration of the human
89 nature (Jacobs, 2019). For instance, when we eat meat, we absorb the vibration
90 of the instinctive creatures into our nerve system and this amplifies our own lower
91 nature which in turn aggravates fear, anger, jealous, lethargic qualities.
92 Furthermore, killing innocent animals for the purpose of filling stomach is a bad
93 karma (deed) with harmful consequences (Szucs *et al.*, 2012).

94 In Christianity, religious regulations governing food and drink differ widely from
95 having no restrictions to abstaining from meat or dairy products. The biblical
96 concept of God's dominion over man and man's dominion over animals is still the
97 foundation of the attitudes of many towards human beings and animals

Religious and regulatory concerns

(Gatward, 2001). Based on this theory, Catholic and protestant faiths do not have any restrictions on animal diet. However, Seventh Day Adventists school of Christians avoid caffeinated, alcoholic beverages, meat and dairy products (Szucs *et al.*, 2012).

In Islam, culmination of series of divine messages to Prophet Muhammad (PBUH) by Allah (s.w.t), describes the way of life intended for humanity that includes the origination of food, its significance and permissibility according to Islamic theology. Food is the source of medium to maintain physical wellbeing and continuity to worship Allah, not just to satisfy the whims. Therefore, any lawful sustenance is allowed, unless there is evidence to prohibit it (Latif and Aziz, 2018). Islamic law regulates meat more carefully than other foods. The laws deal with the raising, humane treatment of animals and slaughter of food animals as exhibited in the Holy book of Quran (Kassam & Robinson, 2014).

Global food regulation

Ever since its inception in 1963, the *Codex commission* facilitates International food trade across the globe. The primary objective of the Commission is to ensure consumer protection and fair food trade practices across the globe by developing International food standards, guidelines, and codes of practice. While establishing the guidelines, it also takes it in to consideration the strategies and guidelines of FAO and WHO, OIE, and of other intergovernmental organizations.

It is not uncommon that any emerging technology is subjected to highly polarized debates on their development, use and safety (Mandel *et al.* 2008; Kahan *et al.*, 2007). In the case of cultured meat, both proponents and opponents express

Religious and regulatory concerns

121 their advocacy on pros and cons of the technology while regulators evaluate
122 safety measures to ensure consumer protection prior to approval.

123 The role of Codex commission in assessing and regulating newly emerging food
124 products is very vital and timely action avoids differentiations between national
125 legislations which would impede efforts for harmonization. For instance,
126 according to the European Union (EU) food consisting of, isolated from or
127 produced from cell culture or tissue culture derived from animals, plants,
128 microorganisms, fungi or algae are categorized as novel foods (European Union
129 2015/2283) while United States is yet to make statutes and regulation. Recently
130 a joint regulatory framework by USDA and FDA in the name of cell cultured food
131 products has been announced (US FDA, 2018). The Federal Meat Inspection Act
132 (FMIA) of the United States clearly defines meat is made wholly or in part from
133 the carcass of cattle, sheep, swine, or goats. In other words, products derived
134 from the carcass component and edible offal are referred to as meat according to
135 Boler and Woerner (2017). If the regulators take this into consideration, then the
136 products from cultured cells may not fall under meat category. Even if substantial
137 equivalence principle is applied where the final product is expected to be
138 substantially equivalent to their traditional counterpart (no matter how is
139 produced), the content of cultured meat seems to be nutritionally sparse.

140 Although basic macro-nutrients are expected to be present, it is not clear whether
141 they would contain micronutrients and nutritive value comparable to conventional
142 meat. Considering these factors, it remains to be seen how consensus on
143 nomenclature may be achieved.

Religious and regulatory concerns

Nevertheless, meat has historically held many definitions. The word meat is quite surprising as it appears to come from the old English word “mete” referring to food in general. According to Oxford English Dictionary, meat refers to solid (versus liquid) sustenance. It is imperative that the term “meat” seems to center around a sustenance-substance theme. Based on this, narrowing down the term to a specific product coming from the flesh of an animal raised in the ‘traditional’ manner may be challenging. The same case applies to milk also where FDA acknowledged chocolate milk and plant- based soy milk as it did not purport to be or represent itself as conventional milk.

Religion and regulation – friend or foe for animal less meat & milk?

It is believed by almost all religious societies that food is God-given for survival and many of the features that shape dietary habits are derived from religious laws. It is rendered sacred in very different ways, regulating the use of food with diet and food taboos as varied as humankind itself (Rochow, 2009). Religious commitments to food are influenced by several factors, ranging from personal spirituality and experiences to social patterns of belonging as well as ethical, political and doctrinal convictions related to food and eating (Illman, 2015).

As far as Hinduism is concerned, it appears that prevalence of animal sacrifice did exist during Vedic period. However, the defilement caused by eating flesh might have got diminished by the notion that flesh eater would be devoured by the eaten during next birth. In addition, doctrines of ahimsa and dominion theory over nonhuman beings could have also contributed to refrainment at later stages (Kane, 1968). Thus, taking all these factors in to consideration, cultured meat

seems to be well suited for the current scenario as it appears to satisfy both ahimsa and dominion theory in case if this is reasoned out to be the only cause of refrainment. Furthermore, habitual behavior also plays a key role in influencing progressive acceptance of emerging technologies (Riordan and Kleeman, 2015). Nevertheless, development of lab-grown meat in India has already been initiated by Animal welfare organization Humane Society International (HSI) Centre for Cellular and Molecular Biology (CCMB) in Hyderabad.

For Christianity, the supreme Pontiff of Catholic Church represents largest Christian population in the world which advocates “scientific progress was part of the divine plan and introduction of new and more efficient technologies in harmony with sustainable development, is not a threat but a benefit” (Owen, 2003) while referring to genetic modifications in food. The very same principle may be applied to cultured meat also, provided such technologies benefit the man kind as claimed.

As far as Islamic rulings are concerned, everything that is created by Allah (s.w.t.) is in the service of mankind (cf., The Qur'an 45:13). To get the benefits of these creations, we must understand their working rules by scientific reasoning and develop the right kind of technology to get maximum benefits from such creations (Ahsan, 2009). The science and source of cultured meat is Adult Stem Cells (ASCs) from which a portion of meat from the animal's body is taken for further manipulation. According to Hamdan and coworkers (2017), it seems that it is in accordance with the hadith. Nevertheless, the source from which the cultured meat is produced should be taken into consideration. For instance, the

Religious and regulatory concerns

190 animal species must be halal. Secondly, the source of stem cells production
191 should be deemed to be taken from halal slaughtered animal. If the source of the
192 stem cells were taken from a live animal, then the cultured meat produced is
193 unclean and forbidden to be eaten because the hadith clearly forbids it. The
194 nutrient medium in which the culture is grown also plays a vital role from Islamic
195 perspective. Serum (being potentially unclean) should be avoided unless one can
196 prove that meat will not be changed because of contact with serum (Hamdan *et*
197 *al.*, 2017).

198 To this end from the regulators perspective, having safe food is the cornerstone
199 of public health and almost all basic elements of regulatory systems are same
200 around the world. For instance, any new food product or ingredient must be
201 subjected to risk assessment before placing it in the market. In 2006, FAO/WHO
202 have jointly developed a generic risk management framework to enhance food
203 safety regulators understanding and use of risk management in regional and
204 national food safety regulations (FAO/WHO, 2006). Premarket authorization by
205 regulators is a very important prerequisite in almost all the countries to ensure
206 consumer protection (Boer & Bast, 2018). Although long term effect of emerging
207 technology is a grey area of concern, with the aid of quantitative modeling and
208 structural simulation, the foreseeable risks and preventive controls can be
209 predicted (Liu & Gasteratos, 2019). Codex commission has a pivotal proactive
210 role in framing the guidelines as culture meat comes closer to being available
211 commercially. A meaningful nomenclature is the first step followed by labeling

legislation since labeling helps consumers to identify the product of interest and its contents, allowing them to exercise freedom of choice (Premanandh, 2012).

Concluding remarks

The phenomenon of creativity is unique to human beings resulting in novel technologies and processes that are aimed at improving and/or replacing the existing ones. Ever since the introduction of genetically modified foods in 1994, new food technologies face close scrutiny and are often met with skepticism (Lucht, 2015). Animal free meat and milk is not an exception and the technology are still in its infancy. Nevertheless, the anticipated benefits of the technology seem promising especially when major issues like food security and environmental impact are addressed by such technologies. For instance, the world's population reached 7.7 billion in mid-2019, and expected to reach 10 billion by 2050 (UN, 2019). The amount of food produced is not proportional to the needs to feed the population. Hence alternatives methods for sustainable food production is a necessity given the fact that arable land per person is projected to decrease by 2050 to one-third of the amount available in 1970 (FAO 2016). Mass production of cultured meat in short time utilizing less land area and resources can compensate to feed the world. The meat produced by two cows in about 12 to 18 months by conventional production can be achieved within a month by culturing. In addition, conventional livestock production contributes to global warming through emissions of methane and nitrous oxide. Thus, to defeat the world hunger and provide nutrition for all, animal less meat and milk production have great potential besides reducing animal suffering and associated

problems such as infectious zoonotic diseases and antimicrobial usage to name a few. There are conflicting views on greenhouse gas (GHG) emissions that culture meat may surpass the current levels upon commercial production (Lynch & Pierrehumbert, 2019). Similarly, reduction in the use of antimicrobials is also challenging as nutrient medium in which the cells are grown are prone for contamination by infectious agents (Coecke *et al.*, 2005). Further research on alternative medium should alleviate such challenges for commercialization of cultured meat. Nevertheless, as stated by Blaauboer and coworkers (2016), it is not easy and practical to ensure that food will never pose a risk to consumers. Even policies regarding food safety states a reasonable certainty of no harming of intended use is envisaged (OECD, 1993).

From the religious perspective, there is no visible resistance from religious scholars of at least three major religion in the world as of now and it would be premature to foresee the reaction until the products are commercially available. There is a general notion that religion hinders technological progress. However, the current pace of technological development does not seem to support this especially 81% of the population is religious (Liu *et al.*, 2018). It appears that consumer's acceptance and willingness to buy is increasing according to survey reports (Gaydhane *et al.*, 2018).

Impacts of the ongoing pandemics have resulted in production shocks and trade restrictions thereby decreasing per capita food supply in import-dependent countries (Udmale *et al.*, 2020). Upcoming technologies such as animal free

meal and milk production could be one way of making the food supply chain more resilient despite disruptions due to pandemics.

Resistance to new technologies is heightened when the perceived benefits are abated. Therefore, technologies promoted by large corporations often face stiff opposition from the public. Consumer acceptance remains the wild card in making any technology successful and costing appears to be the prime most factor for food purchases which is influenced by demand and supply. Innovation and technological advancement are very important to shape the future of agriculture and food security and environment for better livelihood. This can only be achieved through appropriate support from all stakeholders failing which feeding the world is going to be a real challenge in years to come.

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Religious and regulatory concerns

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Religious and regulatory concerns

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