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What do popular YouTube videos say about genetically modified foods? A content analysis

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ABSTRACT

Purpose: YouTube is one of the most popular media sharing platforms that facilitates both professionals and lay people to participate in dissemination of knowledge and opinions. Its wide-reaching impact allows both top-down and bottom-up flow of information between experts and lay audience. With a vast proportion of Americans obtaining health-related information digitally, the purpose of this study was to describe the content of 100 most viewed YouTube videos in the English language, specific to genetically modified foods (GMFs).

Methods: Using the search terms "genetically modified foods" the URLs and metadata for 100 English YouTube videos with the highest viewership were curated. Each video was viewed, and dichotomously coded for the absence or presence of ten content categories. Descriptive statistics, percentages of categorical variables and independent one-tailed t-tests ($\alpha = .05$) were conducted to assess the statistical effect of the absence or presence of these categories on the number of views and likes garnered by the videos.

Results: Cumulatively, the 100 videos observed received 65,536,885 views and 1,328,605 likes. Only 7% of the videos were created by professionally credentialed individuals or organizations. More than 90% of the sampled videos described GMFs with an example, 50% mentioned their role in alleviating hunger, and 65% mentioned ecological concerns attributed to GMFs.

Conclusions: Our results underscore the need for health professionals to increase their digital presence on online media sharing platforms such as YouTube, and capitalize on its pervasiveness as potential conduits of accurate scientific information to equip consumers make evidence-based, informed decision regarding GMFs.

1. Introduction

Genetically modified foods (GMFs) are foods derived from genetically modified organisms, which in turn have their genetic material intentionally altered through genetic engineering to meet the need of a desired trait [1,2]; this process of specific gene manipulation is distinct from traditional selective breeding or natural genetic recombination [1]. Increased disease resistance and herbicide tolerance, faster growth rates with lesser need for water and soil resources, improved nutrition and taste, as well as reliable and increased yields that facilitate increased global availability and reduced food prices are among the many advantages attributed to genetically engineered foods [1,3]. As per the Food and Agriculture Organization (FAO), in 2019 there were an estimated 690 million undernourished people globally [4]. Gene modification is part of a multi-pronged strategy to address global hunger that is partially driven by underlying agricultural currents of limited arable land, climate change, emergence of new agricultural pests and diseases as well as yield plateau [3]. At the other end of the spectrum, apprehension regarding GMFs center around their threat to biodiversity, as well as their potential for unintended gene transfer, antibiotic resistance and allergenicity [5].

Given these polarizing views, the continual debate about the use of GMFs is pervasive. The average consumer's attitude towards this controversial topic is largely informed by scientific literacy and public perception regarding GMFs [6]. Research suggests that consumer understanding of GMFs is low [7], despite the commonality of negative sentiment on the topic [8]. In a review analyzing consumer sources of information regarding GMFs, Wunderlich and Gatto concluded that consumers base their informed opinion on the topic based on information conveyed through the media and internet [7]. Despite concerns regarding accuracy of the information conveyed, media sources have been successful in wide dissemination of scientific information, even though the target audience may not voluntarily seek out scientifically backed information [9].

YouTube is among the most popular video-sharing website with a monthly global viewership of more than 2.6 billion people. The platform

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is used by more than 95% of the internet population, has local versions in more than 90 countries and 76 distinct languages [10]. Almost three-quarters of adult Americans, and 90% of young adults aged 18-24 years report using this Google-owned video-sharing website [11]. Further, twenty-six percent of US adults get news on YouTube and consider it "an important way to stay informed [12]."

Considering the wide-ranging accessibility of YouTube, this study aimed to describe the content of 100 most viewed YouTube that covered genetically modified foods.

2. Methods

The methodology for this study was adapted from a recent study analyzing the coverage of Genetically Modified Foods on Google News [13]. In this cross-sectional study, the search term "genetically modified foods" was used on YouTube™ to identify 100 videos in the English language with the highest viewership. These videos were cataloged on July 17, 2022 for further coding. For each video, the URL, number of thumbs-up (or likes), number of views as well as the source of the video (consumer, professional, internet-based news), were recorded. All videos were watched in entirety and analyzed for coverage of topics outlined in consumer education websites published by the World Health Organization [1], and the United States Food and Drug Administration [14]. As a first step, the information in the consumer education websites was categorized into the following 10 consolidated categories to develop a coding scheme: definition of GMFs (with examples); how to identify GMFs; how are GMFs regulated; their identification and regulation; potential for GMFs with improved nutritional quality; potential for GMFs to alleviate hunger by improving yield and growth under wide-ranging environmental conditions, as well as resistance to herbicides, insecticides and pathogens; unknown long-term effects of GMFs on human health; unintended environmental effects such as ecological imbalance, effects on other species, and/or gene transfer; increased risk for allergenicity, increased use of pesticides and/or herbicides, as well as transfer of antibiotic resistance; unintended economic consequences; and contribution of GMFs to a better environment. Each video was coded dichotomously for the absence (coded as "0") or presence (coded as "1") of each of the above categories. While the categories were relatively broad, they were mutually exclusive, a single video contained multiple categories. A second researcher repeated the dichotomous coding for a tenth of the videos selected by a random number generator. A high reliability score ($\kappa = 0.933$) as calculated by Cohen's kappa indicated high inter-rater reliability. Descriptive statistics and percentages of categorical variables, independent one-tailed t-tests ($\alpha = .05$) were conducted on MS Excel. Since the study did not involve human subjects, it was not subject to review by the Institutional Review Board at Lehman College.

3. Results

Cumulatively, the 100 videos observed received 65,536,885 views and 1,328,605 thumbs up. The average number of views for all videos was approximately 655,369 with a standard deviation of 2,992,574.23. The average number of thumbs up received by all videos was roughly 13,286 with a standard deviation of 72,771.67. Among the videos, 45% were created by a consumer, 7% by a professional, 48% were internet-based news or entertainment.

Table 1 shows the 10 content characteristics considered when screening the 100-video sample in its first column. This table also shows the number (N) of videos that included this content, the total number of views that videos with this content garnered, and the total number of thumbs up that videos featuring this content received. Over 90% of the sample explained GMFs and provided examples (N = 91). Almost two-thirds of the study sample mentioned the unintended impact of GMFs on ecological imbalance and/or gene transfer (N = 65). Over 50% discussed that the long-term health effects of GMFs were not known (N = 57). Videos that included the afore-mentioned categories also garnered the most views and likes. Less than a quarter of the videos addressed the unintended economic results of GMFs (N = 24), and a little over a fifth mentioned the contribution of GMFs to a cleaner environment (N = 21).

A total of 22 independent one-tailed t-tests ($\alpha = .05$) were run to determine if any of these 10 content characteristics had a statistical effect on the number of views or number of thumbs up a video received. The resulting p-values are included in Table 1. Of these 22 tests, there were only 2 that returned significant results. Videos that included a definition of GMFs with an example significantly received more views than those that did not ($p = .0413$, 708,493 views vs. 118,225 views). Videos that addressed identification of GMFs garnered a significantly lower number of views than those that addressed this topic ($p = .0368$, 113,641 vs. 987,395). Coverage of none of the content categories statistically impacted the number of likes garnered by the videos.

4. Discussion

The current information age is characterized by a deluge of data from different sources as well as an increased magnitude in information delivery platforms via the internet [15]. Democratization of information has resulted in more grassroots participation in information dissemination, as a result of which evidence-based health-specific information may be oversimplified, re-interpreted or re-framed in a manner that is vastly distinct from the original intent [15]. With more than 90% of Americans using the internet, and 80% of internet users estimated to conduct online health-related searches via the internet [16], it is noteworthy that digital

Table 1
Distribution of Content Categories in 100 YouTube Videos on Genetically Modified Foods.

Content Categories	No. of videos	Views			Thumbs Up			Proportion (%) of videos covering content			
		Number	%	p-value (t-test)	Number	%	p-value (t-test)	Consumer	Professional	Internet news	p-value (χ^2 test)
Total	100	65,536,885	100		1,328,605	100		45	7	48	
Explains GM FOODS and/or provides examples	91	64,472,856	98.38	0.041	1,299,738	97.83	0.095	86.7	100	93.8	0.338
Unintended Impacts on other Species and/or Ecological Imbalance and/or Gene transfer	65	55,902,841	85.30	0.109	1,227,629	92.40	0.079	55.5	71.4	72.9	0.200
Long-term health effects on human beings not known	57	48,072,438	73.35	0.207	1,138,255	85.67	0.115	57.7	57.1	56.3	0.989
Increased yield/ suitability for growth under varied conditions/ potential to alleviate hunger	50	25,793,825	39.36	0.322	596,214	44.88	0.426	64.4	71.4	33.3	0.006
Regulation of GMFs	47	8,690,200	13.26	0.060	124,202	9.35	0.074	42.2	28.6	54.2	0.308
Transfer of antibiotic resistance, toxicity and allergenicity and/or resistant weeds or increase use of pesticide/herbicide	44	18,003,842	27.47	0.218	510,489	38.42	0.211	37.7	57.1	47.9	0.473
Increased nutritional quality of food	39	23,637,547	36.07	0.442	579,795	43.64	0.429	35.6	71.4	37.5	0.186
Identification of GMFs	38	4,318,376	6.59	0.037	58,143	4.38	0.055	35.6	28.6	41.7	0.722
Unintended Economic Consequences	24	5,108,327	7.79	0.081	97,344	7.33	0.113	15.5	42.9	29.2	0.148
Contributing to a cleaner environment	21	17,532,325	26.75	0.379	482,307	36.30	0.248	22.2	42.9	16.7	0.273

literacy is considered as one of the "super social determinants of health" [17]. It is therefore of utmost importance that the source of online health-related information be vetted for accuracy. With YouTube as one of the popular media-sharing platforms, there is high probability of disseminating misleading health information as well as the potential for effective information resource when used by authoritative sources [18]. A recent health advisory published by the U.S. Surgeon General advocating for a healthy, online information environment, recommends that professional organizations deliberately utilize digital technology and media platforms for circulation of authoritative, evidence-based public health information [19]. With only 7% of the videos analyzed in this study, being professionally authored, our results indicate a missed opportunity by health and food science professionals to capitalize on the pervasiveness of YouTube to communicate accurate information to the lay person regarding genetically modified foods and equip them to make an informed evidence-based decision on such a controversial topic.

With respect to a controversial topic as genetically modified foods, appropriate health communication involves including content material that explains the underlying principle of genetic engineering. Majority of the videos in this study (91%) included an explanation with examples of GMFs. Arguably, these videos had significantly higher viewership than those that did not explain what GMFs are. The potential for GMFs to combat food insecurity and world hunger have been attributed to their potential for increased yield, resistance to abiotic and biotic stress, food quality and safety [20]. In our study sample, 50% of the videos mentioned the contribution of GMFs in addressing global hunger through any of the aforementioned means; these videos contributed to more than 39% of the views and 45% of the likes received.

Despite the impact of GMFs in improving crop productivity as a means to alleviate global hunger, a vast proportion of individuals are apprehensive about embracing the scientific advances in this field. Some of the consumer concerns are attributed to the absence of consensus within the scientific community regarding food safety and environmental concerns attributed to GMFs, specifically increased antibiotic resistance, pesticide tolerance, allergenicity and unintended gene transfer [21]. Within our study sample, 65% of the videos mentioned the role of GMFs on ecological imbalance due to gene transfer. Although these videos comprised more than 85% and 92% of the views and likes/thumbs up garnered respectively, inclusion of this topic did not significantly impact the number of views ($p = .109$) and likes ($p = .079$). Another important caveat with respect to GMFs is consumer concern regarding the paucity of scientific data on the long-term health effects of GMFs, 57% of the videos addressed this concern and contributed to more than 73% of the views and 86% of likes, although without statistical significance ($p = .207$ and .115 respectively). Consumer apprehension is also due to lack of public awareness, inconsistent labelling and regulation policies across countries, as well as absence of credible and independently collected scientific data on risk assessment [3].

The differences among various countries in regulatory framework for release and commercialization of GMFs adds to the shift in research focus and public's hesitancy to embrace GMFs. For example, the United Sates regulatory process has a more relaxed approach towards GMFs based on the understanding that regulation should focus on the final product rather than the gene-modification process involved in the inception of the product, thereby decreasing the regulatory implication on developers of GMFs [14]. In contrast, the more stringent process in the European Union takes into consideration the genetic engineering process undertaken to produce the food [22]. These differences in the regulatory processes have resulted in higher rates of approval of GMFs within the United States as compared to Europe [23]. In our study, 47% of the sample videos mentioned regulation of GMFs, with no statistical effect on the number of views ($p = .06$) and likes ($p = .074$).

Majority of the videos (93%) in our study sample were produced by consumers and internet news (Table 1); apart from explaining GMFs, a large proportion of these videos focused on unintended environmental impacts of GMFs, such as gene transfer and ecological imbalance. GMO's have the potential to hybridize with their wild counterparts and have a fitness advantage which would allow the engineered gene to thrive in the population, thereby decreasing the genetic biodiversity of the wild species [24]. Widespread adoption of GMFs may unintentionally have economic consequences, such as developing countries' continual dependence on Western biotechnology, the need for farmers to continually purchase seeds for each growing season, as well as the administrative costs associated with authorization and regulation [25]; this category of unintended economic effects had among the lowest representation in consumer-sourced videos. Except for the content category related to the potential of GMFs to alleviate hunger ($p = .006$), coverage of all content categories was not statistically impacted by the source of videos. Of note, the least proportion ($\sim 29\%$) of professionally-sourced videos covered identification and regulation of GMFs, the most fundamental aspects of GMFs.

Our study was limited by its small data size, cross-sectional design and inclusion of only videos in the English language, all of which limit generalization of results, especially considering the transitional nature of YouTube videos. Nonetheless, our results underscore the need for health professionals to increase their digital presence on online media sharing platforms such as YouTube, to effectively communicate accurate information on controversial, yet important topics of consumer interest such as GMFs. It would be strategic and effective health communication to capitalize on the pervasiveness of YouTube as conduits of accurate scientific information to equip consumers make evidence-based, informed decision regarding GMFs.

Ethics approval

No; Since the study did not involve participation of human subjects, it was not reviewed by Lehman College's Institutional Review Board.

Informed consent

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Authors' contributions

SB contributed to conceptualization and data collection, JF contributed to data analysis, LS contributed to conceptualization and study design. All authors contributed to manuscript preparation and revision.

Declaration of Competing Interest

The authors have no relevant financial or non-financial interests to disclose.

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