

The Meat of the Matter: The Effect of Science-based Information on Consumer Perception of Grass-fed Beef

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Recommended Citation

O'Brien, Klae D.; Baker, Carrie N.; Bush, Sarah A.; and Wolf, Kattlyn J. (2023) "The Meat of the Matter: The Effect of Science-based Information on Consumer Perception of Grass-fed Beef," *Journal of Applied Communications*: Vol. 107: Iss. 4. <https://doi.org/10.4148/1051-0834.2496>

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Abstract

In the United States, there is a growing disconnect between consumers and their food source, leading to a lack of knowledge and trust in the agricultural food system. Urbanization has moved people away from farms, ranches, and food production; and the information consumers seek about their food is filtered through mass and social media. Portrayals of information about food production, specifically beef, from outside the agriculture industry often present polarizing and conflicting information about beef production and its implications for the health and well-being of humans, livestock, and the environment. This adds to consumer confusion and influences purchasing behaviors. Using a quasi-experimental pretest-posttest 2x2 factorial design, we sought to explore consumer ($n = 60$) perceptions, consumption, and purchasing behaviors of grass-fed beef and determine the effects of four information treatments on overall perception. Descriptive results showed consumers do not have a shared definition pertaining to grass- and grain-fed beef, citing the internet as their most referenced source for information about food and grass-fed beef. Results from a t-test indicated that exposing consumers to an information treatment had a significant effect on environmental impacts, cost, quality/nutrition, and overall perception of grass-fed beef. A between-subjects factorial ANOVA revealed there was no significant difference in perception based on treatment type. Efforts to raise awareness about beef production, on-farm practices, and links between food and grower could be warranted to help enhance the trust and credibility of the industry and bridge the gap between producers and consumers.

Keywords

Consumer perceptions, beef production, trustworthiness

Cover Page Footnote/Acknowledgements

This study was funded through an Undergraduate Research Grant from the Office of Undergraduate Research at the University of Idaho.

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Introduction

In the United States, 10.5% of the working population is employed in the agriculture and food sectors with less than 2% directly employed on farms (United States Department of Agriculture-Economic Research Service [USDA-ERS], 2022a). These trends, along with increased urbanization, suggest consumers have become even further removed from farms, ranches, and food production (Dimitri et al., 2005). This distance has widened the gap in consumers' access to agricultural information, including the understanding of where their food comes from. While some of the information consumers receive about their food may be science-based, some sources promote opinion-based information. When this information is skewed or fails to provide transparent or trustworthy information to consumers, it can decrease agricultural literacy and heighten misconceptions about the agricultural industry. While it is important for the media to do a better job fact checking sources, it also is important for agricultural communicators to explore different avenues for providing science-based information to the public to reduce misconceptions and confusion regarding food production.

Some research suggests 41% of Americans have never or rarely sought out information about how their food was grown or produced (Michigan State University, 2018). However, consumer trend reports suggest 94% of shoppers value knowing how their food is made and are looking for a more transparent food system to help them make decisions at the store (Label Insight, 2016, as cited in Astill et al., 2019). Factors such as the environmental impact, cost, appeal, and nutritional benefits of food drive purchasing decisions (Hati, 2021). Environmental issues and agriculture's role in them have become a major concern to consumers in recent years. Research revealed 55% of consumers say sustainability in agriculture is important and associate sustainable practices with cleaner environments and better health (Kirshenbaum, 2018). Animal agriculture—specifically the beef industry—has come under criticism for its perceived negative environmental impact due to beliefs around its contributions to water and air quality issues (Abdalla & Lawton, 2006). Similarly, consumers have grown increasingly sensitive to concerns about animal welfare on the farm—so much so that these concerns have prevented them from buying products they perceive to be farmed inhumanely (Alonso et al., 2020). Beef producers have responded to these concerns with flexibility and adapted production to meet demand and sustain consumption of beef (Loria, 2022). Throughout these changes, those who have continued to buy beef have called for enhanced traceability and transparency in the food system (Drouillard, 2018). As a result, these consumers are looking for more information and seeking more alternatives—such as specialized beef products they perceive to be more sustainable, healthier, and better for the environment—at the store to curb these concerns (Loria, 2022).

Consumers have a strong desire to make conscious, ethical choices about their food, namely meat, consumption (Abdalla & Lawton, 2006; Alonso et al., 2020; Drouillard, 2018). Yet they know very little about how their food is raised, harvested, and processed and remain at low levels of agricultural literacy (Judd-Murray, 2019). Consumers who desire to make educated choices often seek information from health professionals, government agencies, news and media, and even peers—only to be met with conflicting views about the health and safety of their food and the integrity of the food system (Wu et al., 2021). This lack of clarity leaves many consumers skeptical of animal agriculture and other actors contributing to the food supply chain (Macready et al., 2020). Additionally, this conflicting information may increase questions related to where to access trustworthy, science-based information and what sources to trust.

Individuals do not need to be directly involved in the food system or agricultural production to be agriculturally literate but agricultural communicators can aid in increasing literacy through the creation of engaging, science-based information from trustworthy resources (Lundy et al., 2022). This presents an opportunity for the agriculture industry—namely agricultural communicators—to respond with effective, educational materials that further public understanding of common beef production practices. In doing so, these materials can help consumers differentiate opinion-framed messaging from scientific information to further enhance trust in agriculture and their food system. Therefore, this study aims to understand more about how consumers receive and perceive information about grass-fed and grain-fed beef and how science-based information treatments, presented in four different presentation forms, alter consumer perceptions.

Beef Production and Consumption Trends

In recent years, U.S. meat consumption has been on a steady incline and was marginally higher in 2020 than it has been in the last two decades (Kuck & Schnitkey, 2021). This stands in contrast to trending declines in beef consumption, which remains a somewhat controversial topic, amid consumer concerns and inconsistent information surrounding farm animal welfare and the environment (Kuck & Schnitkey, 2021). Conversely, consumers are increasingly interested in specialized beef products they perceive to be more sustainable, healthier, and better for the environment (Asioli et al., 2017). These increases in purchasing considerations and variations of need have expanded market offerings for value-added beef products, including grass-fed beef. Currently, the U.S. market for grass-fed beef is small, relative to conventional beef (Cheung et al., 2017). However, in July of 2021, “U.S. grass-fed fresh beef sales reached \$776 million, an increase of 5% from the previous year” (Loria, 2022, para. 1). As this market continues to grow, consumers will need reliable information to help them differentiate grass-fed from grain-fed beef and make purchasing decisions.

Terms such as ‘grass-finished,’ ‘pasture-raised,’ ‘meadow-grazed,’ and ‘free range’ are often interchangeably used to refer to grass-fed beef, because there is no protected legislative definition or formal guidelines for the product—either in the United States or European Union (Stampa et al., 2020). In 2007, the USDA’s Agricultural Marketing Service (AMS) released voluntary marketing claim standards to help regulate the labeling of naturally raised and grass-fed meat products, including beef (Morris, 2017). While those were withdrawn in 2016, producers wishing to market grass-fed products can seek approval from USDA’s Food Safety and Inspection Service (FSIS) (Morris, 2017). Currently, grass-fed certifications are no longer federally regulated, but producers wanting to label their products accordingly can either: develop and verify their own standards through USDA-AMS or obtain third-party designation to operate under another recognized standard—which adheres to varying standards for certification (Morris, 2017).

Historically, the USDA has put forth a definition to clarify eligibility in its programs that support grass-fed beef producers. Under this definition of grass-fed beef, the animals’ diet consisted solely of grasses and forage post-weaning—excluding all grains and grain by-products—they have continued access to a pasture and are not confined (USDA, 2019). While not regulatory, this seems to be the definition most widely used and referenced in the context of grass-fed beef production. Amidst such uncertainty and change, industry consensus around what qualifies as grass-fed beef remains largely undefined. Changing oversight on national standards

and the lack of regulation and industry-wide terminology have created confusion for consumers over the years, leading to a concern about false or misleading labels (USDA, 2023). In response, the USDA is leading efforts to strengthen regulations for animal-raising claims in an attempt to “protect consumers from false and misleading labels” (USDA, 2023, para. 1). While the primary concern is based on language associated with antibiotics, there is an opportunity to increase knowledge and educate consumers on other animal-raising practices, such as grass-fed management (USDA, 2023).

Conflicting Information and Consumer Confusion

Consumer demand for more sustainable, healthier food choices created an opportunity for producers to market grass- and pasture-raised beef as a product that aligns with these desires. While in some instances, grass-fed beef can provide benefits over grain-fed beef (Xue et al., 2010), often those benefits are inflated or misunderstood, because they are framed to create a competitive advantage in the market (Lim et al., 2021). Information regarding what some consumers think about grass-fed beef often conflicts with or differs from the evidence put forth by scientists and other experts in animal welfare, nutrition, and environmental science (Lim et al., 2021). As a result, consumer knowledge is relatively low and confusion is high when it comes to what grass-fed beef is, how it is raised, and what benefits it provides (Stampa et al., 2020). Most of the time, these disconnects in perception revolve around environmental impacts; cost and price benefits; or the safety, nutritional benefits, and quality of beef.

Animal Welfare and Environmental Impacts

Because there are no formal definitions, consumers often equate grass-fed beef to a pastoral picture of farming and grazing (Stampa et al., 2020). Previous research suggests this idea of how the beef might be raised on grazing alone contributes to grass-fed beef being perceived as more natural. This in turn causes some consumers to associate the term ‘natural’ with other attributes like greater animal care, environmental consciousness, and food safety (Gassler et al., 2018; Lim et al., 2021). While some consumers may view these products to be healthier, more eco-safe alternatives, these perceptions are not backed by scientific consensus (Lim et al., 2021). Evidence suggests that if we were to transition from a primarily grain-fed system to a grass-fed system across the United States, it would require 100 million head to meet present demand (Hayek & Garrett, 2018). This would reflect a 30% increase in national herd totals, additional methane emissions, and other environmental costs (Hayek & Garrett, 2018). To maintain soil health, more land for grazing would be required, which could compete with agricultural land used for food crop production (Hayek & Garrett, 2018). However, grazing cattle does contribute to other environmental benefits such as soil carbon sequestration, which helps to offset fossil fuel and other human-made emissions (Silveira et al., 2018). This information, which is not always readily available or digestible for consumers, would indicate there are environmental benefits and risks for both grass-fed and grain-fed beef.

Cost, Taste, and Nutrition

In addition to perceived environmental impacts, cost, taste, and nutrition also play a factor in purchasing decisions. While some U.S. consumers report preferring grass-fed over

grain-fed beef, in-store studies revealed consumer intention does not always align with behavior. Xue et al. (2010) uncovered that when presented with the products, the majority of those consumers preferred the appearance of grass-fed beef, but the taste of grain-fed beef. In some instances, taste comes with nutritional tradeoffs that vary depending on the dietary needs of the consumer. Xue et al. (2010) also concluded that consumers' knowledge about nutrients in grass-fed beef impacted their decisions, but only if they were not aware of other foods providing the same nutrient.

In addition to perceived nutritional advantages, cost is another key factor with varying influence on consumers. Because of the scalability and present market share, many current grass-fed producers are small operators with high production costs. These are often reflected in a more expensive product on the shelf, relative to grain-fed beef (USDA-AMS, 2023). The influence of cost varies on consumer choice. Some research suggests consumers perceive animal-friendly products to be healthier, safer, more socially acceptable, and sustainable than conventional beef and report a willingness to pay more for these types of products. However, others are not willing to pay premiums because of the tradeoff in taste (Alonso et al., 2020; Xue et al., 2010).

Information Seeking and Agricultural Literacy

Ultimately, existing literature suggests information about beef and management practices can influence consumers' perceptions of a product and their purchasing decisions. However, the presence of inconsistent and, sometimes, conflicting information can confuse consumers. It is evident information about grass-fed and grain-fed beef is varied and unclear. This—along with sources promoting conflicting information—contribute to consumers' lack of understanding about their food (Rumble & Buck, 2013). Information most accessible and seen by consumers usually does not come from those in agriculture; instead, it comes from mass and social media platforms and other news organizations (Goodwin et al., 2011). This has become increasingly prevalent with the rise of digital influencers (Wielki, 2020). When an influencer, or other media source, portrays a food item in a certain way, it can either positively impact consumers' perceptions or heighten feelings of risk and fear associated with the information (Yadavalli & Jones, 2014). These influences, along with rising rates of urbanization, are just a few factors distancing consumers from food production. As a result, agricultural literacy, or the ability of consumers to “synthesize, analyze, and communicate basic information about agriculture,” (Frick et al., 1991, p. 8) has decreased significantly in the United States (Clemons et al., 2018).

Research posits involvement in the industry and knowledge about agricultural practices shape consumer beliefs and assumptions (Umberger et al., 2009). For example, consumers' perceptions of where and how their beef is raised can influence public opinion, which drives consumption and purchasing decisions. But without access to clear, science-based information to aid in decision-making, consumers may become fearful, skeptical, or lose trust in their food and those who raised it (Wu et al., 2021). Variety in production and beef products is needed and important, not only to advance agriculture but also to provide consumers with choices, based on their unique needs and wants. A role of agricultural communicators is to ensure consumers have the information and resources they need to make confident, informed choices about their food (Lundy et al., 2022). While previous studies have sought to compare grain- and grass-fed beef and understand attitudes toward grass-fed beef, few have examined how the presentation of information consumers receive influences their perception (Nogoy et al., 2022; Xue et al., 2010).

Infographics and Information Validation through Citations

How information is formatted and presented can influence how individuals process certain information about their food (Antúnez et al., 2013). Communications professionals often use visualizations, like infographics, to convey data or science-based information. Infographics are visual depictions of information based on psychology and UX design principles “that aim to reduce barriers to understanding important information” (Otten, 2015, p. 1901). Infographics have been found to enhance an individual’s ability to quickly digest and better understand the information they are reading (Smiciklas, 2012). Visualization of scientific information also expands the potential reach of a message, especially when communicating with diverse audiences with varying levels of literacy and/or those who do not share a common language (Dunlap & Lowenthal, 2016). Infographics can be a powerful tool when communicating food and nutritional information and “serve an important role in bridging the gap between producers and consumers of information” (Otten et al., 2015, p. 1901-1902). Researchers have reported the type of infographic can also influence consumers’ information recall (Holt et al., 2020) and attitudes, in the context of genetic modification (GM) science and food (Lamm et al., 2020). While research demonstrates infographics can be an effective visual communication tool, there is a lack of empirical evidence about the use of infographics in sharing information about beef production practices; and the potential role this content might play in helping consumers digest information and make decisions that align with their needs.

But what makes a good infographic? Research suggests an effective infographic should be compelling and resonate with the audiences, but also coherent—meaning that it “shares a complete and well-formed message that is credible and believable” (Dunlap & Lowenthal, 2016, p. 48). To convey the credibility and integrity of messages science communicators cite trusted, reputable sources. In a study on building consumer trust in the food supply chain, consumers were asked to rank communication strategy statements (Wilson et al., 2017). Consumers ranked ‘transparency,’ ‘credibility,’ and ‘putting consumers first’ as some of the most important strategies for building their trust (Wilson et al., 2017). In each of these categories, emphasis was placed on citing information sources, checking source credibility, and providing references (Wilson et al., 2016). While industry standards and feedback from consumers suggest that the use of citations from sources perceived as trustworthy is best practice when communicating with audiences, there is a lack of empirical evidence that demonstrates if the use of citations on infographics influences consumer perceptions of beef production practices.

Theoretical Framework

Consumers are curious about their food, and they rely on sources they perceive to be trustworthy for information (Wu et al., 2021). With this in mind, social cognitive theory served as the theoretical foundation for this study. Social cognitive theory posits that past experiences, information, biases, and/or opinions one has been exposed to have an impact on their decisions. This encompasses what and why behind how we seek information, build knowledge, and conceptualize truth (Bandura, 1986)—including the “what” and “why” behind the food we buy.

This theory has historically been applied to understand food-related beliefs and behaviors (Byrd-Bredbenner et al., 2011). Research using social cognitive theory revealed expectations and behavior around food are socially regulated in family units and often contribute to closely held beliefs and long-term food habits that are hard to change (Byrd-Bredbenner et al., 2011). This

would suggest that when an individual has only encountered one perspective or information frame, they might be resistant to accepting new information, such as the frame presented in this study. They may even seek out additional sources of information that align with their socially regulated beliefs. This is often referred to as confirmation bias, which occurs when consumers seek information that aligns with their desired food attributes and avoid information that might disconfirm their beliefs (Dickinson & Kakoschke, 2021). This was supported by research which suggested consumers avoided information exposure to conflicting food promotion and even actively sought other mediums to find out information about their food and its safety, depending upon their goals (Cjarzna & Naile, 2012; Dickinson & Kakoschke, 2021).

Research using social cognitive theory has also been employed to inform messaging and communication strategies. In a study of milk consumers, Specht et al. (2017) revealed significant deviations in perceptions of milk between urban and rural shoppers, who were influenced by different grocery store marketing. The researchers concluded that “continuous exposure to pro-organic messages may cause consumers to internalize this information and feel confident in the knowledge they have, regardless of who or where it comes from” (Specht et al., 2017, p. 11). Specht et al. (2017) underscored the importance of exploring where consumers access information and who is contributing to the information in those spaces. While this study was conducted on milk consumers, we can reasonably assume that a similar phenomenon could occur with beef consumers.

In this study, we aimed to employ social cognitive theory by first understanding where individuals obtain their information from and what sources they consider to be trustworthy. Second, we aimed to examine how exposure to information presented in different formats could impact their views. It was important for us to keep in mind the importance of recruiting participants from varying social backgrounds with different predispositions and views on environmental impact, animal welfare, nutrition, and cost preferences.

In addition, when developing communication strategies, the role of transparency is important (Oesterreicher et al., 2018). Therefore, gaining perspective on the influence that transparent references—or the lack of references—had on consumers could provide insight into the value individuals place on knowing where information comes from. Additionally, infographics “provide an effective means to communicate health and nutrition data to decision makers, who need high-quality information but in bite-size readily accessible forms” (Otten et al., 2015). Research on consumer perceptions of grass-fed beef and their response to messaging can inform industry best practices for communicating about grass-fed and grain-fed beef and can be applied to issues addressing comparative food products and consumer choices.

Purpose and Objectives

The purpose of this study was to identify how consumers receive and perceive information about grass-fed and grain-fed beef. Additionally, we aimed to understand how science-based information treatments, presented in four different presentation forms, alter consumer perceptions. The following research objectives guided this study:

- O1: Describe the consumers’ perceptions, consumption, and purchasing behaviors of grass-fed beef.
- O2: Describe the sources and trustworthiness of sources consumers use to receive information about their food and grass-fed beef.
- O3: Examine the effects of an information treatment on perceptions of grass-fed beef.

- O4: Based on the information treatment received, examine differences in the effects on perceptions of grass-fed beef.

Methods

For this quasi-experimental study, we utilized a pretest-posttest two-by-two factorial design to analyze differences between consumers' perceptions of grass-fed beef (Ary et al., 2018). Participants completed a pre-test prior to receiving one of four randomly assigned treatments, a post-test, and a demographic survey. In this study, we used an online Qualtrics survey to gather responses from consumers. We conducted this study with funding awarded through an undergraduate research grant from the Office of Undergraduate Research at the University of Idaho.

Population and Sampling

We recruited participants through social media, email list serves, and newsletters of various community- and campus-based organizations, clubs, and associations in the Palouse. We used a purposive sampling frame of organizations, chosen based on their location and missional focus on either agriculture or environmentalism. Targeting smaller, homogenous groups is valuable in developing messages and testing their effectiveness (Davis, 1995). Given the potential polarity of grass-fed and grain-fed beef, we attempted to recruit participants from an equal number of organizations that might favor either more conventional or alternative production.

Participant demographic responses are displayed in Table 1. Participants ranged in age from 18 to 73 years old, with the majority identifying as White/Caucasian ($n = 55$), which demographically reflects the geographic region in which our study was conducted. Of the participants, 63.3% ($n = 38$) were female and 36.7% were male ($n = 22$). Most participants lived in rural or suburban areas ($n = 51$). Our participants also had varying levels of education. While the majority held either a bachelor of science ($n = 16$; 26.7%) or a master of science ($n = 17$; 28.3%) degree, 21.7% ($n = 13$) indicated they had some college experience, but did not earn a degree. Fewer had associate, professional, or advanced degrees. The household income of participants ranged from less than \$30,000 to \$150,000 or more. While the highest concentration of participants having an annual income of \$70,000-99,999, there was immense variation in the other income levels.

Table 1

Demographics of Participants (n = 60)

		<i>f</i>	<i>%</i>
Gender	Female	38	63.3
	Male	22	36.7
Ethnicity	White/Caucasian	55	91.7
Education	Some College, no degree earned	13	21.7
	Associates or Technical	6	9.7
	Bachelor of Science	16	26.7
	Master of Science	17	28.3

	Professional	1	1.7
	Doctorate	7	11.7
Area	Rural	34	56.7
	Suburban	17	28.3
	Urban	7	11.7
Income	Less than \$30,000	9	15.0
	\$30,000 to \$39,999	3	5.0
	\$40,000 to \$49,999	9	15.0
	\$50,000 to \$69,999	11	18.3
	\$70,000 to \$99,999	13	21.7
	\$100,000 to \$149,999	11	18.3
	\$150,000 or more	3	5.0

Note. Other ethnicities were not included for the small response size. No participants indicated their level of schooling as high school/GED equivalent or no high school degree.

Instrumentation

The survey contained two parts: 1) nine preliminary items on beef consumption, information sources, and perceived trustworthiness, and six demographic questions; 2) and a 25-item pre-test and post-test, following a treatment. We used previous literature (Evans et al., 2011; Font-i-Furnols & Guerrero, 2014; Gerber et al., 2015; Hayek & Garret, 2018; Mountjoy, 2011) and a review from a panel of experts in the meat science and beef industries to create the 25-item instrument measuring perceptions of grass-fed beef. Additionally, we pilot tested the instrument with an agricultural communications and community leadership class. We selected this pilot group because they were able to provide feedback on the treatment designs. As assessed by both the panel of experts and through pilot testing, we determined the instrument to be valid and reliable for usage in the study. We used this instrument for both the pre-and post-test.

We asked nine questions related to beef consumption in the following order. We asked participants to indicate how often they consume beef with options from never to four or more times per week (never, 1-11 times per year, 1-3 times per month, once a week, 2-3 times a week, or 4 or more times a week). Participants also selected all that applied for the cuts of beef they eat most often. Options included: steak, roast, ribs, hamburger, and “other” with an option to fill in a response. We then asked participants “have you eaten grass-fed beef in the past year?” as an open-ended question. Participants indicated how often they choose grass-fed over grain-fed beef on a scale from always to never (*always, usually, sometimes, rarely, never*). When asked where they typically get their information about the foods they eat and where they first learned about grass-fed beef, participants were presented with the options: internet, television shows about food, news stories about food, books about food/cookbooks, food magazines, and “other” with another open-ended response opportunity. Participants were allowed to provide multiple answers.

For question seven, we asked participants to multiselect as many options as they wanted for what the term “grass-fed beef” means to them. This question also had an “other” option with a fill-in-the-blank option. The final two questions in this section requested participants to rank their perceptions. Item eight stated “rank the following from the most to least important in your purchasing choice” and included freshness, where it was raised, taste, price, health benefits, how it was raised, brand, and appearance as options based on those indicated in previous research

(Evans et al., 2011; Font-i-Furnols & Guerrero, 2014; Gerber et al., 2015; Hayek & Garret, 2018; Mountjoy, 2011). Item nine asked participants to rank sources from most trustworthy to least trustworthy sources. In this question, we presented participants with government agencies, associations and organizations, and social media sources to see how individuals would rank other sources compared to social media. Additionally, we asked participants to provide their age, gender, ethnicity, education, the area they live in (urban, suburban, or rural), and household income.

To develop the rest of the instrument and treatment, we did a review of the literature that revealed environmental impact, cost, animal welfare, and quality/nutrition to be among the top determinants in purchasing choices related to beef and other meat products (Font-i-Furnols & Guerrero, 2014; Hayek & Garret, 2018). Participants ranked each of the 25 statements on a Likert scale from 1 (*strongly disagree*) to 5 (*strongly agree*). The environmental impact construct asked their opinion on grass-fed beef's impact on soil health, water and air quality, and methane production (Gerber et al., 2015; Hayek & Garret, 2018). Items included statements such as “grass-fed beef is produced in a more environmentally friendly way,” “the water quality is better on farms/ranches with grass-fed beef,” and “grass-fed beef reduces methane production.” The cost construct examined if individuals are willing to pay more for grass-fed beef and what impact cost has on purchasing choice (Evans et al., 2011). Example items included “If cost was not a factor, I would primarily purchase grass-fed beef” and “I am willing to pay more for a grass-fed hamburger.” In the animal welfare construct, the individuals indicated their beliefs about the need for antibiotic usage and raising and grazing practices of grass-fed beef (Hayek & Garret, 2018). Items included statements such as “grass-fed beef is raised more humanely,” “grass-fed beef is all natural,” “grass-fed beef is produced in a way that lowers the likelihood of needing antibiotics.” Lastly, the quality/nutrition area specifically examined the participants' perceptions of taste and nutritional differences between grass-fed and grain-fed beef (Font-i-Furnols & Guerrero, 2014; Hayek & Garret, 2018; Mountjoy, 2011). Example items included “grass-fed beef tastes better than grain-fed beef,” “grass-fed beef is healthier for people to eat than grain-fed beef,” and “grass-fed beef has healthier fat than grain-fed beef.”

Scores on the instrument ranged from 25 to 125, with a higher score indicating more positive perceptions towards grass-fed beef. The subscales ranged from 5 to 25 for environmental impact, cost, and animal welfare and 10 to 50 for quality/nutrition. The overall scale indicated an excellent Cronbach's (1951) alpha level at .946, with subscales indicating acceptable alpha levels: environmental impact: $\alpha = .767$, cost: $\alpha = .762$, animal welfare: $\alpha = .883$, and quality/nutrition: $\alpha = .906$.

Treatment

For the treatment, the undergraduate researcher—a agricultural communications student—assisted with the development of the four treatments. The four treatments included: 1) an infographic without citations; 2) an infographic with citations; 3) a plain written document without citations; and 4) a plain with document with citations. These four treatments contained the same information about grass-fed and grain-fed beef, sourced from the literature. We chose this format to see if infographics could have the same influence on consumer perception as a plain written document. Additionally, we sought to determine if references to scientific research would influence changes in perception.

The information included a definition for both grass-fed and grain-fed beef; nutritional information related to minerals, fatty acids, protein, and cholesterol; information on environmental impact related to finishing time; current costs at Walmart; antibiotic and growth hormone information; and information related to animal welfare (Environmental Protection Agency [EPA], 2018; Font-i-Furnols & Guerrero, 2014; Gerber et al., 2015; Mountjoy, 2011; USDA, 2019). In an attempt, to ensure the information was not framed in a way that favored one practice more than the other, all treatments were reviewed by a panel of communication experts in the beef industry who represented both the grass-fed and grain-fed sectors. Additionally, following the collection of the instrument in the pilot test, we asked individuals in the agricultural communications and leadership courses to provide feedback on all four treatments. Pilot participants indicated the treatments presented information that could have the potential to change responses on the post-test.

Data Collection and Procedures

To begin the data collection process, we compiled a list of 16 community- and campus-based organizations, clubs, and associations in the Palouse. For our purposive frame, we chose organizations based on their location and missional focus on either agriculture or environmentalism. We then used a recruitment email to ask these organizations, clubs, and associations to promote our survey through social media, email listservs, and/or newsletters. We had nine organizations agree to promote our survey through social media, email listservs, and/or newsletters. If an organization shared in their newsletter, they were also asked to post the survey link on social media or email through their listserv. We initially contacted organizations on February 24, 2020—requesting posts be made between April 1-30, 2020. We provided the nine organizations who agreed to distribute the survey with a recruitment statement for their email, social media posts, and/or newsletter. We designed the social media posts for both Facebook and Instagram. We helped coordinate the dates that each organization would share the survey and scheduled a reminder for them to send follow-ups two weeks later. It is worth noting that the COVID-19 pandemic impacted the original window for data collection. Because of this, we extended the window to collect data until May 10, 2020 and allowed some flexibility in the distribution of recruitment emails and posts. However, we did ensure that each organization distributed both an initial and reminder email or post.

We collected survey results through an anonymous survey link and yielded 60 complete responses ($n = 60$). This survey took approximately 20 minutes to complete. Participants who completed the survey and provided contact information were entered into a drawing to win one of five VISA gift cards worth up to \$250 (one \$250, two \$100, and two \$50). First, participants responded to demographic items and preliminary questions about their beliefs and behaviors as a consumer. They then completed the 25-item pre-test.

Following the pre-test, we provided participants with one of the four randomly assigned treatments: 1) infographic without citations; 2) infographic with citations; 3) plain written document without citations; or 4) plain written document with citations. As we previously stated, these four treatments contained the same information. After we presented participants with the treatment, they continued to the post-test portion, where they responded to the same 25 items. Following the post-test, we provided participants with an opportunity to enter the drawing for the gift card incentives.

Data Analysis

We used descriptive statistics including frequencies, percentages, means (M), and standard deviations (SD) to describe participants' demographics, beef consumption, preferred sources of beef communication and their perceived trustworthiness, and pre- and post-test scores. To examine the effect of the treatment on perceptions of grass-fed beef, we utilized paired t-tests to compare differences in pre- and post-test results. We then used a between-subjects factorial ANOVA to examine citation (citations vs. without citations) effects, presentation (infographic vs. plain document) effects, and interaction (citation * presentation) effects, which allowed us to compare changes in perception based on the treatment each participant received. We set a significance level of less than .05 a priori to the study. During the analysis, we ensured that all statistical assumptions were met. In general, a two-way ANOVA procedure is considered robust to violations of normality. Because group sizes were not equal, Levene's test was used to confirm the homogeneity of variance assumption was not violated. All groups reported significance levels greater than .05. Because participants were assigned to separate, online treatments and were independent of every other group observation, the assumption of independence for the between-subjects factor was met.

Results

Consumers' Perceptions, Consumption, and Purchasing Behaviors

Our first objective was to describe participant perceptions, consumption, and purchasing behaviors pertaining to beef and specifically grass-fed beef (Table 2). Beef consumption varied for our participants from never ($f = 4$, 6.7%) to four or more times per week ($f = 10$, 16.7%). Many of our participants consume beef either two to three times per week ($f = 18$, 30%) or one to three times per month ($f = 21$, 35%). Of the participants, 87% reported hamburger as most often consumed cut of beef ($f = 52$), followed by steak at 65% ($f = 39$). The majority of participants ($f = 56$) noted on an open-ended question that they had consumed grass-fed beef in the past year. However, only a small number of individuals noted that they always ($f = 5$) or usually ($f = 10$) choose grass- over grain-fed. In fact, 23.3% ($f = 14$) indicated they never make that choice.

We asked participants to select all the statements that represented what the term 'grass-fed beef' means to them. The majority, 71.7% of participants responded with "raised and grazed on an open pasture," while 38.3% selected "finished on grass, but not always raised in a pasture." Twenty-three participants reported grass-fed beef as "never fed grain" (38.3%) or "finished on grass, but not always raised in a pasture" ($f = 23$; 38.3%). Less participants selected raised naturally, organically, antibiotic-free, or hormone free. No participants selected the "other" option.

Table 2*Consumption of and Characteristics, Behaviors, and Beliefs about Grass-Fed Beef (n = 60)*

Item	<i>f</i>	%
How often do you eat beef?		
Never	4	6.7
1-11 times per year	7	11.7
1-3 times per month	21	35.0
Once a week	0	0.0
2-3 times per week	18	30.0
4 times or more per week	10	16.7
Have you eaten grass-fed beef in the past year?		
Yes	56	93.3
No	4	6.7
How often do you choose grass-fed beef?		
Never	14	23.3
Rarely	14	23.3
Sometimes	17	28.3
Usually	10	16.7
Always	5	8.3
What statements describe what “grass-fed beef” means to you? ^a		
Raised and grazed on an open pasture	43	71.7
Never fed grain	23	38.3
Finished on grass, but not always raised in a pasture	23	38.3
Raised naturally	17	28.3
Raised organically	10	16.7
Raised antibiotic free	10	16.7
Raised hormone free	7	11.7
What are the most important factors influencing purchasing choice? ^b		
Freshness	34	56.7
Price	33	55.0
Taste	30	50.0
How it was raised	27	45.0
Where it was raised	21	35.0
Appearance	16	26.7
Health benefits	10	16.7
Brand	1	1.7

Note. ^a This response option was “Select all that apply.” Frequencies and percentages reflect the multi-select option. ^b Participants were asked to rank these factors from most to least important. Frequencies and percentages are reflective of how many times each appeared in their top three rankings.

We asked participants to rank the most to least important factors influencing their purchasing decisions and used their top three choices to determine the most important influences on purchasing choice. When choosing beef, the most important influences on their choice were freshness (56.7%, *f* = 34), price (55.0%, *f* = 33), taste (50%, *f* = 30), and how it was raised (45%,

$f = 21$). The least important were where it was raised (35%, $n = 21$), appearance (26.7%, $f = 16$), health benefits (16.7% ($f = 10$), and brand (1.7%, $f = 1$).

Sources and Trustworthiness

Table 3

Participants' Information-Seeking Behaviors and Perceived Source Trustworthiness (n = 60)

Item	<i>f</i>	%
Where do you typically get information about the foods you eat? ^a		
Internet	34	56.7
Books	25	41.7
News stories about food	18	30.0
Food magazines	9	15.0
Television shows about food	7	11.7
Academic works	5	8.3
Farmers/Producers	4	6.7
Family and Friends	1	1.7
Where did you learn about grass-fed beef? ^a		
Internet	23	38.3
Books	14	23.3
News stories about food	14	23.3
Other	14	23.3
Television shows about food	8	13.3
Academic works	6	10.0
Food magazines	6	10.0
Farmers/Producers	3	5.0
Which of the following sources are the most trustworthy? ^b		
United States Department of Agriculture (USDA)	55	91.7
Social media sources	47	78.3
Environmental Protection Agency (EPA)	39	65.0
National Cattlemen's Beef Association (NCBA)	20	33.3
People for the Ethical Treatment of Animals (PETA)	7	11.6
Food and Drug Administration (FDA)	3	5.0

Note. ^a This response option was "Select all that apply." Frequencies and percentages reflect the multiselect option. ^b Participants were asked to rank these factors from most to least trustworthy. Frequencies and percentages are reflective of how many times each appeared in their top three rankings.

Our second research objective aimed to understand where consumers seek information about their food and examine the perceived trustworthiness of various information authorities when it comes to their food, specifically beef (Table 3). Results indicated the internet was where individuals most commonly get their information on the food they eat (56.7%, $f = 34$) and learn about grass-fed beef (38.3%, $f = 23$). For learning about grass-fed beef, the internet was followed by books, news stories about food, and other sources all at 23.3% ($f = 14$). Other responses varied but included personal connections like family and friends, local grocery stores, and specific organizations. Participants revealed that they turn to farmers and producers the least for

information about their food (6.7%, $f = 4$) and for learning about grass-fed beef (5%, $f = 3$). When asked to rank information sources from most to least trustworthy, overall, participants viewed the United States Department of Agriculture (USDA) as the most trustworthy (91.7%, $n = 55$). Other top-ranked sources for trustworthiness were social media (78.3%, $f = 47$), the Environmental Protection Agency (EPA) (65%, $f = 39$), and National Cattleman's Beef Association (NCBA) (33.3%, $f = 20$). Participants viewed People for the Ethical Treatment of Animals (PETA) (11.6%, $f = 7$) and the Food and Drug Administration (FDA) (5%, $n = 3$) as the least trustworthy sources.

The Effects of an Information Treatment on Perceptions of Grass-fed Beef

We used paired samples t-tests ($n = 60$) to determine the effect of an information treatment on participants' overall perceptions of grass-fed beef and perceptions pertaining to environmental impact, cost, animal welfare, and quality/nutrition. Table 4 shows pretest-posttest mean differences for each perception construct. Higher scores on the pre-test indicated more favorable views toward grass-fed beef. Findings indicated the information treatment resulted in a decrease in the overall perception of grass-fed beef, $t(59) = 3.41$, $p = .001$; environmental impact, $t(59) = 3.46$, $p = .001$; cost, $t(59) = 3.38$, $p = .001$; and quality/nutrition, $t(59) = 3.07$, $p = .003$. The effect size was roughly medium for overall perception ($d = .44$), environmental impact ($d = .45$), cost ($d = .44$), and quality/nutrition ($d = .40$).

Table 4

Mean Differences for Perceptions of Grass-fed Beef at Pre- and Post-test ($n = 60$)

	<i>Pre-test</i>		<i>Post-test</i>		<i>t</i>	<i>p</i>	<i>Cohen's d</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
Overall Perception	80.73	18.80	75.82	18.76	3.41	.001**	0.44
Environmental Impact	15.87	3.66	14.17	4.03	3.46	.001**	0.45
Cost	16.47	5.16	15.27	5.51	3.38	.001**	0.44
Quality/Nutrition	32.12	8.10	30.21	7.30	3.07	.003*	0.40
Animal Welfare	16.28	4.43	16.17	4.31	0.25	.800	0.03

Note. Higher scores indicate more favorable views toward grass-fed beef. Significance at the * $p < .05$ level and ** $p < .001$, 2-Tailed.

Differences of the Effects, Based on the Information Treatment

Our final research objective aimed to examine if there would be significant mean differences in changes of perception of grass-fed beef between the pre- and post-tests, based on the treatment received (format of the information). We conducted a between-subjects factorial ANOVA to examine the effect of presentation style and citation use on overall perceptions of grass-fed beef. There was not a statistically significant interaction between the effects of presentation style and citation use, $F(1,56) = .151$, $p = .699$. Simple main effects analysis showed that presentation style did not have a statistically significant effect on overall grass-fed beef perception, $p = .275$. Citation use also did not have a statistically significant effect on perception, $p = .115$. The results of the factorial ANOVA can be found in Table 5.

Table 5

Factorial ANOVA for Presentation Style and Citation Use

Source	Sum of Squares	<i>df</i>	Mean Square	<i>F</i>	<i>p</i>	η^2
Presentation style	149.29	1	75.82	1.21	.275	.021
Citation use	315.39	1	14.17	2.56	.115	.044
Presentation style * citation use	18.63	1	15.27	1.51	.699	.003

Note. Significance at the $p < .05$ level.

Conclusions & Recommendations

It is important to note that our study was not without limitations. Despite collecting 78 responses, we only had 60 usable pretest-posttest responses from a singular geographic area. As an attempt to curb nonresponse, we did outline participant expectations and provided the opportunity for an incentive. Because of the observed mortality, we employed Mann-Whitney and t-tests to handle non-response bias by comparing early and late participants (Linder et al., 2001). We did not observe any significant differences. Second, results can only be generalized to individuals belonging to the organizations and associations in the Palouse. Framing effects are focused on more homogenous audiences and thus, this choice was intentional in our study design but warrants recognition. Finally, we delivered our treatment online. Though the transition toward digital marketing has moved toward multimedia presentation of information—including infographics—the materials we created are also commonly viewed in print. We do not have data on engagement with a treatment in a traditional print format. These should be kept in mind as we discuss our conclusions and recommendations.

Findings from this study suggest that consumers have some understanding of differences between grass-fed and grain-fed beef. However, there were variations in selections for the definition of grass-fed beef. This supports the idea that confusion might exist within the beef market due to a lack of market regulations (Stampa et al., 2020; USDA, 2023) and the need for education and outreach on beef products. Overall, the information intervention did, at a nearly moderate effect size, influence perceptions of the differences between grass- and grain-fed beef, which indicates the information presented did influence changes in perceptions and knowledge of beef products. This supports the need for additional efforts to ensure consumers receive science-based, comparative information that helps them understand the differences between grass- and grain-fed production and beef consumption. It is important this information is framed without further polarizing or compromising either sector.

Our sample of consumers demonstrated varied patterns of beliefs and behaviors around grass- and grain-fed beef. The majority of participants reported eating beef more than monthly—if not multiple times per week. Some indicated in an open-ended response that they have eaten grass-fed beef in the past year. However, only a small percentage said they “always” or “usually” choose grass-fed beef. This could be due to a variety of mediating factors not explored in this study. For example, those who fell into this category might not be the primary food decision-maker in their household or might not be willing or able to pay the premium. This sentiment aligns with literature that says previous consumption often influences perception and preference but does not always translate to a willingness to pay (Xue et al., 2010). Additionally, it is

important to note that grass-fed beef is commonly advertised at restaurants in the Palouse, which may have contributed to a high number of participants knowing they had consumed grass-fed beef without actively selecting it. Future research should be conducted to understand beef consumption and how intention influences decision-making at the point of purchase in this geographic region.

Further, results indicated that participants' understanding of what grass-fed beef is and how it is defined was vast and varied, much like previous literature suggests (Stampa et al., 2020). However, the majority of participants did recognize that grass-fed beef is defined by criteria, albeit broad, around grazing practices and feed. The top three responses most closely align with the definition put forth by the USDA (2019) which states to be considered grass-fed beef: 1) grass and forage should be the primary feed source; 2) the animal should have consistent pasture access; and 3) they should not be fed grain or byproduct. While chosen with lesser frequency, a noteworthy number of participants chose definitions pertaining to how the animal is raised (i.e. organic, hormone-free, natural, antibiotic-free). These definitions are not rooted in the USDA (2019) definition but *do* reflect perspectives often promoted in beef marketing and the confusion that often leads to a lack of concern around misleading labels (USDA, 2023). Ultimately, these responses indicated some knowledge level of the beef industry. They also supported findings from Rumble and Buck (2013) and De Graaf et al. (2016) which revealed that judgments about agricultural products are often based on inaccurate information from a variety of sources. A consensus, industry-accepted definition of beef products would be valuable to help alleviate consumer confusion. This definition would also help both grass- and grain-fed beef producers make decisions related to raising cattle and marketing beef products. This recommendation aligns with those proposed by the USDA's recent (2023) call for strengthened regulations. Findings also point to a need for continued education and effective communication about beef practices so consumers can make informed choices that align with their personal preferences and/or dietary needs.

In looking at purchasing behaviors, participants indicated freshness, price, and taste are most influential to their decision to purchase beef. This aligns with previous literature that says perceived fresh- or naturalness and taste lead to product purchase and repeat consumption of grass- or pasture-raised products (Getter et al., 2014; Umberger et al., 2009). However, this finding conflicts with other research that suggests values and attributes like health and nutritional benefits, environmental concerns, and animal welfare are more important to consumers (Stampa et al., 2020). However, participants may not feel they have sufficient information on these factors to contribute to decision-making, which could lead to reluctance to buy (Stampa et al., 2020). We recommend further exploring this phenomenon.

Participants reported their top mediums for accessing information about food and beef were the internet, books, and news stories about food. These findings align with previous research that identified the internet and news channels as the top medium for seeking information about beef and related food safety (Charanza & Naile, 2012). Historically, books have not been a medium explored as frequently, but with the return to reading in recent years, this could be a medium of interest to consider for sharing information about beef and beef production. A low number of participants reported they are likely to turn to farmers and producers for information about their food and grass-fed beef. This could be due to their lack of access to farmers and producers in their area or could indicate a lack of trust in these sources. Previous research by De Graaf et al. (2016) revealed consumers were hesitant to rely on the agriculture industry and farmers as trusted sources of information.

Additionally, based on social cognitive theory, we would have expected more participants to report family or friends as a source (Byrd-Bredbenner et al., 2011). However, only one participant shared this source as where they accessed their information about food. While we acknowledge a limitation in this study was not providing family and friends as a choice, we still would have expected more individuals to indicate them in the other section. We recommend future research on how family and friends as mediums compare to these other mediums—or provide the connection to these other mediums. For instance, how do family and friends—as well as past experiences—lead an individual to specific internet sites or news channels? While they may not have been identified directly, social cognitive theory would suggest they most likely select their mediums based on recommendations and experiences with others (Bandura, 1986). Further research is needed to understand the motivations behind information-seeking and trustworthiness. Efforts to raise awareness about beef production, on-farm practices, and links between food and grower could help to enhance the trust and credibility of the industry and bridge the gap between producers and consumers.

Other notable findings included the perception that the USDA, social media, and EPA were the most reputable and trustworthy sources for information on grass-fed beef. This both supports and contradicts previous research which suggests that the government is seen as a trustworthy source of information about food (De Graaf et al., 2016) and that many individuals gain access to information through social media platforms (Goodwin et al., 2011). We added social media to see if participants would rank it among other sources. Based upon our results, we recommend that agricultural communicators utilize social media as a platform to highlight USDA, other governmental organizations, and science-based research findings to increase agricultural literacy. We recommend conducting additional research to examine how different sources might impact consumers' views of the information. Additionally, further exploring why sources are viewed as trustworthy, or not, would aid in a greater understanding of the public perception of issues in the beef industry.

Effect of Treatment

The results from the information treatment part of this study indicate 1) consumers are receptive to science-based information; and 2) digestible, summarized briefs can have an impact on their perceptions towards grass-fed beef. However, results from the two-way ANOVA revealed perception change was not significantly different, based on the type of treatment participants received, regarding citation use or format. This raises additional questions on how individuals determine the trustworthiness of the information provided, especially considering social media was seen as one of the most trustworthy sources. How do consumers determine science versus opinion on social media? This concept should be examined further through additional research. We also recommend creating educational platforms to support education around the importance of source credibility and science- versus opinion-based information.

In looking at the overall mean differences, animal welfare was the only construct that did not show statistically significant changes in perceptions from pre- to post-test. This aligns with previous research which suggests consumers' beliefs on animal welfare are usually deeply rooted and unlikely to change with new information about production practices and benefits for animal welfare (Gwin et al., 2012). This connects with Bandura's (1986) social cognitive theory that posits how we conceptualize truth is often influenced by our experiences, including our beliefs on food habits (Byrd-Bredbenner et al., 2011). In our treatment, we identified that means

differences decreased slightly. This did not indicate to us that perceptions were necessarily changed, but perhaps the treatment did not provide enough information to alter current perceptions based on preference experiences and beliefs. Research suggests that over time, knowledge about both grain- and grass-fed production is directly associated with certain attitudes that influence purchasing beef (De Graaf et al., 2016). Therefore, we recommend considering different avenues for increasing agricultural literacy on animal welfare related to different farming and ranching practices.

By creating messages that draw on science, the agriculture industry can provide clear, transparent information to consumers to educate, rather than persuade (Oesterreicher et al., 2018). Given grass- and grain-fed beef both contribute to the advancement of agriculture and consumer choice, it is critical that practitioners like nutritionists, product marketers, industry communication specialists, environmental advocacy groups, and even agricultural producers are equipped with the tools and resources they need to market their product—without spreading misinformation or exacerbating consumer confusion. Presenting science-based information to consumers can have an impact on their perceptions towards beef. Given that we saw the perception did not change based on the type of treatment received, additional research with a larger, nationwide sample is needed to support these findings. Additional research could assist agricultural communicators understanding of how consumers engage with the information provided and determine their preferences for the way the information is presented.

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