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Consumer Awareness, Use, and Perceptions of Biodiesel in Northwest Arkansas

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Abstract

Biodiesel is a liquid transportation fuel produced primarily by transesterification of vegetable oils, waste grease, or animal fats and used as a replacement fuel in diesel engines. Fuel customers (*N* = 134) at three Northwest Arkansas retail fuel outlets were interviewed to determine their awareness, use, and perceptions of biodiesel. A majority (70.7%) of customers was aware of biodiesel; however, only 6.7% had ever purchased biodiesel. Respondents aware of biodiesel (n = 94) responded to a series of 10 statements to assess their perceptions of biodiesel. A large number of respondents were uncertain of biodiesel's quality (41.5%), performance (44.2%), and effects on engine repair and maintenance (52.1%). Despite these uncertainties, only 12.9% either agreed or strongly agreed they would never use biodiesel. A majority of respondents agreed or strongly agreed that it was better to use biodiesel because it is renewable (88.1%) and that use of non-food crops to produce biodiesel was justified (76.6%). Respondents were almost evenly divided in their levels of agreement with using food crops to produce biodiesel (strongly disagree or disagree = 45.2%; strongly agree or agree = 47.3%). Sizeable percentages of consumers were undecided if biodiesel reduced harmful exhaust emission (36.2%) or if increased biodiesel use would decrease global warming (43.0%). To the extent these consumers are typical of others, the need exists to develop and implement programs to educate consumers and voters about biodiesel.

***Keywords*:** biodiesel, consumers, awareness, perceptions, use

Introduction

Liquid biofuels have received renewed interest among the public, government, and industry due to diminishing petroleum supplies, increasing energy demands, the geographical concentration of known petroleum reserves, and concerns about the environment (Koonin, 2006; Rojey & Monot, 2010). The U.S. Energy Independence and Security Act of 2007 mandated that 136 billion liters of renewable biofuels be in use by 2022 (Schnepf & Yucobucci, 2010). This represents approximately 28% of the 477 billion liters of gasoline consumed in the U.S. in 2010 (U.S. Energy Information Administration, 2011). Likewise, the National 25x'25 Alliance, comprised of U.S. leaders in agriculture and forestry, has set a goal that farms and ranches will produce 25% of U.S. energy by 2025 (Acker, 2008).

Biofuels were defined by Weins, Fargione, and Hill (2011) as "all non-fossil energy sources derived from biological materials" (p. 1,085). The two primary types of liquid biofuels are ethanol and biodiesel. Ethanol, used in spark-ignition engines, is made primarily from sugar-producing (sugar cane and sugar beets) or starch-producing (wheat and corn) crops by fermentation processes (Naik, Goud, Rout, & Dalai, 2010). Biodiesel, used in compression-ignition engines, is primarily produced by transesterification of vegetable oils, waste grease, or animal fats (Rojey & Monot, 2010). In 2010, an estimated 86 billion liters of ethanol and 19 billion liters of biodiesel were produced worldwide (REN21, 2011), representing approximately 3.3% of all liquid transportation fuels (U.S. Energy Information Administration, 2011).

Commercially available liquid biofuels are considered to be first generation biofuels, because they are produced primarily from food crops (cereals, sugar crops, and oil seeds) using mature technologies (Sims, Mabee, Saddler, & Taylor, 2010). Although there is strong political and agricultural industry support for first generation biofuels, not all critics have been convinced of the net benefits of increased production and use. Some question the performance (Skipper, 2007), environmental and economic impacts (Lehrer, 2010), and food availability and cost effects (Pimentel et al., 2009) of first generation biofuels. While there is a great deal of scientific interest and on-going research concerning second generation biofuels (produced from non-food feedstocks such as lingo-cellulose and algae), commercialization is estimated to be a decade or more in the future (Sims et al., 2010).

Availability of Biodiesel in the U.S.

According to the National Biodiesel Board (n.d.) there are 841 retail outlets in the U.S. where biodiesel or biodiesel blends may be purchased. These retail outlets are not distributed uniformly across the country; rather, the largest concentration is in the Midwest. The concentration of retail outlets in the Midwest is primarily due to the availability of biodiesel feedstocks (such as soybeans and animal fats) (Bantz & Deaton, 2006; Stewart & Lambert, 2011). Because biodiesel is primarily transported by truck, rail, or barge, as opposed to pipelines, retail outlets tend to cluster around biodiesel plants, which, in turn, are located near available feedstock supplies (McElroy, 2008). Thus, awareness, use, and attitudes toward biodiesel may be spatially variable (Van de Velde, Verbeke, Popp, Buysse, & Hullenbroeck, 2009).

Knowledge about Biofuels

Among the general public, knowledge about renewable energy is limited and there is a perceived lack of information, particularly in the case of biofuels (Kinsey, Peterson, & Haines, 2003; Van de Velde, Vandermuelen, Huylenbroeck, & Verbeke, 2011). Skipper (2007) surveyed U.S. consumers about the importance they placed on selected fuel characteristics. The

following were rated as either 'important' or 'very important' by more than 75% of respondents: availability (96.7%), quality (91.2%), price (87.8%), performance (83.2%), environmental friendliness (81.9%), effects on maintenance costs (81.6%), and ability to use fuel without engine modification (77.3%). Skipper also found that a majority of respondents either 'agreed' or 'strongly agreed' that biofuels were still in the experimental stage of development (70.9%) and could only be used in modified engines (53.4%). Additionally, significant percentages were 'undecided' if biofuels led to increased maintenance costs (61.5%), were high-performance fuels (45.0%), met quality standards (35.9%), or would lead to engine damage (30.8%).

According to Acker (2008) research and education must play key roles in meeting the U.S. National 25x'25 Alliance's renewable energy goals. One of the major enabling research priorities (Acker, 2008) is to "assess consumer behavior and attitudes towards renewable energy" with the goal of understanding perceived advantages and concerns (p. 57).

Attitudes toward Biofuels

Ulmer, Huhnke, Bellmer, and Cartmell (2004) examined Oklahoma consumers' attitudes toward ethanol-blended gasoline. A majority of respondents believed switching to an ethanol blend would have no effect on vehicle performance (52.4%) and that ethanol was better for the environment than gasoline (57.7%). A majority (59.2%) of respondents indicated that reduced U.S. dependence on foreign oil was the greatest benefit of ethanol-blended gasoline. No significant relationship was found between consumers' willingness to purchase an ethanol blend and the demographic variables of gender, education, income, age, or urban versus rural residence. These results partially conflict with previous research indicating that females (Zelezny, Chua, & Aldrich, 2000) and younger adults (Gronhoj & Thogersen, 2009) have more pro-environmental attitudes than males and older adults.

Jensen, Clark, and English (2012) examined regional differences in U.S. consumers' willingness to pay for biofuels and determined that consumers in southern oil-producing states (Louisiana, Oklahoma, and Texas) and in the Northeast were less willing to pay a premium for biofuels compared to consumers in in the mid-south (Arkansas, Kentucky, and West Virginia). The researchers suggested these differences were related to oil industry employment (southern oil-producing states) and greater access to public transportation (Northeast).

Kinsey et al. (2003) found that nearly one-half (43.8%) of diesel fuel customers in southwest Idaho had not heard of biodiesel. Nearly two-thirds (65.6%) agreed they would purchase biodiesel if it was conveniently available, but only 18.7% agreed that it was easy to get biodiesel in their area. Similar to Ulmer et al. (2004), a majority of respondents agreed that biodiesel reduced dependence on foreign oil (71.9%) and contributed to a cleaner environment (62.5%). Consistent with Skipper (2007), a majority of respondents were unsure if biodiesel was better for their engines (75.0%) or if their vehicles performed better with biodiesel (84.4%) than with petroleum diesel.

Sallee, Davis, Johnson, Edgar, and Wardlow (2010) examined Arkansas secondary agriculture students' knowledge and attitudes about biodiesel before and after a two-hour educational program. On the pretest, students had little factual knowledge about biodiesel and a fairly positive attitude toward biodiesel. Following the educational program, the mean student knowledge score increased significantly (107%), but there was no significant change in the mean attitude score. Sallee et al. (2010) concluded that increasing student knowledge about biodiesel, while important, had little if any effect in changing student attitudes.

The findings of Sallee et al. (2010) are consistent with previous research that concluded consumer attitudes toward renewable energy topics are developed primarily through affective,

not cognitive, processes (Hartman & Apaolaza-Ibanez, 2012). According to Bang, Ellinger, Hadjimarcou, and Traichal (2000):

> Our results suggest many consumers are saying, 'I do not know much about renewable energy, but I am very concerned about current environmental conditions. I also believe that renewable energy has clear advantages even though I do not really know a lot about it' (p. 464).

Media Framing of Biofuels

Chang (2009) defined a frame as the overarching thematic structure used by the media to present a news story. Research has shown that individual judgments often depend on how an issue is framed by the news media and other opinion leaders (Chang, 2009; Druckman, 2001; Van de Velde et al., 2009). Wright and Reid (2011) analyzed *New York Times'* stories from 2006 to 2008 and identified three consistent frames used when reporting about biofuels; namely (a) economic development (49.2%); (b) environment (33.5%); and (c) national energy security (17.3%). Additionally, Chang (2009) identified fuel vs. food as a commonly used media frame for reporting on biofuels. The food vs. fuel frame portrays increased biofuel production resulting in decreased food production and/or increased food prices. The acceptance of biodiesel could be improved by utilizing alternative communication channels that may overcome national, geographic, social and cultural, or organizational and institutional boundaries (Jensen, Halvorsen, & Shonnard, 2011). Furthermore, educational programs could play an important role in increasing the adoption of biodiesel.

Theory of Reasoned Action

The theory of reasoned action (TRA) (Ajzen & Fishbein, 1980) posits that human actions, such as using biodiesel, are guided by three considerations: (a) beliefs about the consequences of an action (behavioral beliefs), (b) beliefs about the normative expectations of others (normative beliefs), and (c) beliefs about the presence of factors that may promote or hinder the behavior (control beliefs). Taken as a whole, these beliefs lead to the formation of behavioral intentions that serve as precursors to behavior (such as use or non-use of biodiesel).

According to the TRA (Ajzen & Fishbein, 1980), if potential consumers believe that using biodiesel has negative consequences (such as reduced engine performance or increased food prices), they are less likely to use biodiesel. Similarly, if others in their reference groups do not use biodiesel, individual consumers are less likely to use biodiesel. Finally, when the consumer market for biodiesel in a geographic area is limited, few if any biodiesel suppliers are likely to exist, posing yet another barrier to biodiesel use (Van de Velde et al., 2011).

Bang et al. (2000) evaluated the efficacy of the TRA (Ajzen & Fishbein, 1980) in explaining U.S. consumers' willingness to pay a premium for renewable energy. The researchers found support for the TRA in that consumers who were more concerned about the environment were more knowledgeable about renewable energy (and, thus, assigned more positive consequences to renewable energy use) and were more willing to pay a premium for renewable energy than those having less knowledge and concern about the environment.

Problem Statement

U.S. consumers will play an important role in the future development and use of biodiesel in their roles as voters and consumers (Cortese, 2003). Yet, few recent studies have examined consumers' perceptions of biodiesel, as opposed to ethanol or the more generic construct, 'biofuels.' This study specifically seeks to quantify consumers' awareness, use, and perceptions of biodiesel in order to identify potential barriers to consumer use.

Purpose

The primary purpose of this study was to determine the awareness, use, and perceptions of biodiesel among retail fuel consumers in Northwest Arkansas. A secondary purpose was to determine the relationships between selected demographic variables and awareness, use and perceptions of biodiesel among retail fuel consumers in Northwest Arkansas.

Methods

Data reported in this study were collected by interviewing fuel customers at three Northwest Arkansas retail fuel outlets over the course of five two-hour interview periods in August and September 2012. Approximately 185 customers were approached for interviews and 134 interviews were conducted. Since the interview respondents were not randomly selected and no attempt was made to compare respondents and non-respondents, no inferences to any larger population of consumers is warranted. Thus, only descriptive statistics were used in data analyses.

All interviews were conducted by the same two researchers using a printed interview guide. The interview guide was a modified version of a printed instrument developed by the researchers, based on a review of the literature related to consumer perceptions of biofuels (Halder et al., 2011; Kulscar & Bolender, 2011; Pimentel et al., 2009; Popp et al., 2009; Skipper et al., 2009; Selfa, Kulscar, Bain, Goe, & Middendorf, 2010; Vogt, Cantrell, Carranza, Johnson, & Peters, 2008; Xue, Grift, & Hansen, 2011), and used in a previous study (Johnson, Edgar, & Edgar, 2012). The interview guide was modified by reducing the number of items and by adding a verbal script in which the researchers identified themselves and their university, explained the purpose of the study, specified the likely time required to complete the interview, and asked potential interviewees whether or not they were willing to participate.

The interview guide consisted of three parts. Part I contained three questions (with a “yes” or “no” response option) asking respondents whether they owned or drove a diesel vehicle, whether or not they had heard of biodiesel prior to the interview, and whether or not they had ever purchased biodiesel or a biodiesel blend. Part II consisted of 10 items, measured on a 5-point scale (“strongly disagree” to “strongly agree”), measuring customer perceptions of biodiesel. Part III consisted of three demographic items related to the respondents’ age, gender, and miles driven per week. The second question of Part I, whether or not the respondent had previously heard of biodiesel, was used as a screening question. When a respondent reported not being familiar with biodiesel, the interviewer skipped Part II and proceeded directly to the demographic items (Part III). Respondents eligible to complete Part II (perceptions of biodiesel) were handed printed cards listing the five possible response options (“strongly disagree,” “disagree,” “neither agree nor disagree,” “agree,” or “strongly agree”) to each statement.

The original printed instrument on which the interview guide was based had been previously evaluated by a panel of five individuals with expertise in survey methods (*n = 2),* biofuels research (*n* = 2) and biofuels marketing (*n* = 1) and judged to possess face and content validity. The original instrument had been administered twice, at a 14 day interval, to seven undergraduate students resulting in coefficients (*r*) of stability of 1.0, 0.81, and 0.99, for sections one, two, and three, respectively. The interview guide was pilot-tested with four undergraduate students, who reported no difficulty in understanding the directions or interview items.

Results

A majority of interview participants (*N* = 134) were male (62.1%) and the average respondent was 38.02 (SD = 16.15) years old, with ages ranging from 17 to 77 years. The respondents reported driving a median of 100 miles per week in their personal vehicles, with reported mileages ranging from 2 to 1,000 miles per week.

Less than 1 in 10 (9.0%) respondents reported owning or driving a diesel vehicle, but approximately 7 in 10 (70.7%) indicated they had heard of biodiesel. Of those respondents having heard of biodiesel, only 9.9% had ever purchased biodiesel or a biodiesel blend (Table 1). Assuming the 43 individuals not aware of biodiesel had also never purchased biodiesel, only 6.7% of those interviewed had ever purchased biodiesel.

Table 1. Participant vehicle types and awareness and use of biodiesel.

Question	*n*	Yes (%)	No (%)
Do you currently own or drive any vehicle that runs on diesel?	134	9.0	91.0
Had you ever heard of biodiesel before I mentioned it?	134	70.7	29.3
Have you ever purchased biodiesel or a biodiesel blend?	91[a]	9.9	90.1

[a] Respondents indicating they had never heard of biodiesel were not asked this question.

Awareness and use of biodiesel were analyzed to determine if there were meaningful correlations between these two variables and respondent gender, age, miles driven per week, and ownership or use of a diesel vehicle. Using Davis' (1971) descriptors for the magnitude of correlation coefficients, the levels of association (Table 2) between these variables were negligible to low, explaining less than 2% of the variance in responses to either question.

Table 2. Correlations (*r*) between awareness and purchase of biodiesel and selected consumer demographic variables.

	Demographic Variable			
Question	Gender[a]	Age	Miles driven per week	Own or drive diesel vehicle?[b]
Had you ever heard of biodiesel before I mentioned it?[b]	-.14	.05	-.05	.15
Have you ever purchased biodiesel or a biodiesel blend?[b]	.08	.05	.14	.10

[a] Coded as "male" = 0 and "female" = 1. [b]Coded as "no" = 0 and "yes" = 1.

Slightly over one-half (53.2%) of respondents who were aware of biodiesel either agreed or strongly agreed that biodiesel was a high quality fuel (Table 3). However, 41.5% of respondents neither agreed nor disagreed with this statement, indicating a large degree of uncertainty among consumers regarding biodiesel quality. Likewise, a majority of respondents (52.1%) were uncertain if using biodiesel resulted in increased repair and maintenance costs while a plurality (44.2%) were uncertain whether or not diesel engines would run properly on biodiesel. Despite their apparent uncertainty about biodiesel, only 12.9% agreed or strongly agreed they would never use biodiesel, while 77.4% disagreed or strongly disagreed with the statement. Less than one in ten (9.6%) respondents agreed that biodiesel was available at most fueling locations in their area; not a single respondent (0.0%) strongly agreed that biodiesel was widely available in their area.

Table 3. Consumer perceptions of biodiesel quality, performance, and availability.

	Level of Agreement						
Statement	Strongly Disagree (%)	Disagree (%)	Neither Agree nor Disagree (%)	Agree (%)	Strongly Agree (%)	*M*[a]	*SD*
Biodiesel is a high quality fuel (*n* = 94)	1.1	4.3	41.5	42.6	10.6	3.57	0.78
Use of biodiesel results in increased repair and maintenance costs (*n* = 94)	2.1	30.8	52.1	12.8	2.1	2.82	0.76
Diesel engines will not run properly on biodiesel (*n* = 86)	14.0	31.4	44.2	10.5	0.0	2.51	0.86
I would never use biodiesel.	26.9	50.5	9.7	9.7	3.2	2.12	1.02
Biodiesel is available at most fueling locations in my area (*n* = 94)	13.8	55.3	21.2	9.6	0.0	2.27	0.82

[a] Coded as "strongly disagree" = 1, "disagree" = 2, "neither agree nor disagree" = 3, "agree" = 4, and "strongly agree" = 5.

Consumer perceptions of biodiesel quality, performance, and availability were correlated with the demographic characteristics of gender, age, miles driven per week, and ownership or use of a diesel vehicle. Using Davis' (1971) descriptors, the levels of association (Table 4) between these variables were negligible to low, explaining less than 7% of the variance in responses to any of the five statements.

Table 4. Correlations (*r*) between perceptions of biodiesel quality, performance, and availability and selected consumer demographic variables.

	Demographic Variable			
Question	Gender[b]	Age	Miles driven per week	Own or drive diesel vehicle?[c]
Biodiesel is a high quality fuel[a]	-.11	-.25	-.03	-.14
Use of biodiesel results in increased repair and maintenance costs[a]	.14	-.05	.06	.00
Diesel engines will not run properly on biodiesel[a]	.07	.08	-.22	-.12
I would never use biodiesel[a]	.17	.15	.06	.08
Biodiesel is available at most fueling locations in my area[a]	.10	.19	.03	.02

[a] Coded as "strongly disagree" = 1, "disagree" = 2, "neither agree nor disagree" = 3, "agree" = 4, and "strongly agree" = 5.
[b] Coded as "male" = 0 and "female" = 1.
[c] Coded as "no" = 0 and "yes" = 1.

Almost 8 in 10 (78.1%) respondents either agreed or strongly agreed that it was better to use biodiesel because biodiesel is made from renewable resources (Table 5). Likewise, over three-fourths (76.6%) agreed or strongly agreed that using non-food crops to make biodiesel was justified. However, there was an almost even split between the percentages that strongly

disagreed or disagreed (42.5%) and those that agreed or strongly agreed (47.4%) that using food crops to make biodiesel was justified.

Slightly over one-half (53.2%) of respondents agreed or strongly agreed that biodiesel produces fewer harmful exhaust emissions than petroleum diesel (Table 5). A sizeable percentage (36.2%) of respondents was uncertain about whether or not biodiesel reduced harmful exhaust emissions. Approximately equal percentages of respondents were undecided (43.0%) or either agreed or strongly agreed (42.0%) that increased use of biodiesel would reduce global warming.

Table 5. Consumer perceptions of renewable and environmental aspects of biodiesel production and use.

	Level of Agreement						
Statement	Strongly Disagree (%)	Disagree (%)	Neither Agree nor Disagree (%)	Agree (%)	Strongly Agree (%)	*M*[a]	*SD*
It is better to use biodiesel because it is made from renewable resources (*n* = 91)	0.0	7.7	14.3	55.0	23.1	3.93	0.83
Using non-food crops to make biodiesel is justified (*n* = 94)	2.1	10.6	10.6	61.7	14.9	3.77	0.91
Using food crops to make biodiesel is justified (*n* = 93)	12.9	32.3	7.5	38.7	8.6	2.98	1.26
Biodiesel produces fewer harmful exhaust emissions than petroleum diesel (*n* = 94)	1.1	9.6	36.2	41.5	11.7	3.53	0.86
Increased use of biodiesel will reduce global warming (*n* = 93)	2.2	12.9	43.0	32.3	9.7	3.34	0.90

[a] Coded as "strongly disagree" = 1, "disagree" = 2, "neither agree nor disagree" = 3, "agree" = 4, and "strongly agree" = 5.

Using Davis' (1971) descriptors, there were moderate, negative correlations between age and agreement with using food crops to make biodiesel and agreement that biodiesel produces fewer harmful exhaust emissions (Table 6). Respondent age explained 10.9% of the variance in the level of agreement that using food crops to produce biodiesel is justified and 13.7% of the variance in agreement that use of biodiesel reduces harmful exhaust emissions. In both cases, older respondents were less likely to agree with these two statements. All other correlations between the demographic variables and the statements about the renewable and environmental aspects of biodiesel were negligible to low (Davis, 1971), explaining 6.3% or less of the variance in respondents' levels of agreement.

Table 6. Correlations (*r*) between perceptions of renewable and environmental aspects of biodiesel production and use and selected consumer demographic variables.

	Demographic Variable			
Question	Gender[b]	Age	Miles driven per week	Own or drive diesel vehicle?[c]
It is better to use biodiesel because it is made from renewable resources[a]	-.24	-.21	-.04	.03
Using non-food crops to make biodiesel is justified[a]	.03	-.02	.05	.09
Using food crops to make biodiesel is justified[a]	-.25	-.33	.03	-.02
Biodiesel produces fewer harmful exhaust emissions than petroleum diesel[a]	-.07	-.37	-.09	-.19
Increased use of biodiesel will reduce global warming[a]	-.19	-.24	-.01	-.10

[a] Coded as "strongly disagree" = 1, "disagree" = 2, "neither agree nor disagree" = 3, "agree" = 4, and "strongly agree" = 5.
[b] Coded as "male" = 0 and "female" = 1.
[c] Coded as "no" = 0 and "yes" = 1.

Discussion, Conclusions and Recommendations

This study sought to determine the awareness, use and perceptions of biodiesel among fuel customers at three Northwest Arkansas retail fuel outlets. Since these outlets and customers were not randomly selected, no generalizations should be made to any larger population.

Approximately 7 in 10 (70.7%) Northwest Arkansas customers interviewed in this study were aware of biodiesel. This is a higher level of awareness than reported by Kinsey et al. (2003) in a 2002 study of southwest Idaho consumers, where only 56.2% were aware of biodiesel. However, given that the current study was conducted 10 years later than the Kinsey et al. (2003) study, the increased level of awareness of biodiesel is less than dramatic. Despite the availability of biodiesel since the 1970s and recent renewed interest, approximately 30% of these consumers were unaware of biodiesel. To the extent to which these consumers are representative of others, additional public education about biodiesel is warranted.

Only 9.0% of the consumers studied reported owning or driving a diesel vehicle. Also, there were only low, negligible correlations (Davis, 1971) between owning or driving a diesel vehicle and being aware of biodiesel (r = .10) or having ever purchased biodiesel (r = .15). Further, 69.1% of these consumers either strongly disagreed or disagreed that biodiesel was available at most fueling locations in their area. Thus, the biodiesel market for these three retail fuel outlets (none of which sold biodiesel) may be limited by a self-reinforcing feedback loop of no biodiesel supply and little or no biodiesel customer demand (Van de Velde et al., 2009).

Xue et al. (2011), in a review of 162 scientific studies of biodiesel use, concluded that biodiesel blends of up to 20% (B20) are similar to petroleum diesel as an engine fuel. However, even among the 94 consumers (70.7%) aware of biodiesel, there was a large degree of uncertainty about biodiesel quality, effects on repair and maintenance costs, and engine performance. This high level of uncertainty should be a concern given Skipper's (2007) finding that more than 75% of consumers rated these same fuel characteristics as being either "important" or "very important" factors in their fuel purchasing decisions. If the consumers included in the current

study are similar to other consumers, additional public education concerning biodiesel quality and performance is warranted. The finding that only 12.9% of consumers either agreed or strongly agreed they would never use biodiesel provides support for the conclusion that education may be an effective tool in promoting biodiesel use.

The consumers interviewed tended to agree with the positive statements concerning the renewable aspects of biodiesel production and use, especially when non-food crops are used to make biodiesel. Respondents were about evenly split concerning the desirability of using food crops to produce biodiesel. These findings support those of Bang et al. (2000) and Hartman and Apaolaza-Ibanez (2012) indicating that consumers largely evaluate renewable energy technologies through affective rather than cognitive processes and exhibit a bias toward the perceived goodness of renewable technologies.

A slight majority (53.2%) of consumers either agreed or strongly agreed that biodiesel produced fewer harmful exhaust emissions as compared to petroleum diesel; however, 36.2% of the respondents were uncertain of biodiesel's effects on emissions. Xue et al. (2011) concluded that use of biodiesel results in an overall decrease in harmful engine emissions. Thus, additional public education is needed in this area to inform consumers of these scientific results.

The correlations between respondents' demographic characteristics and their awareness, use, and perceptions of biodiesel were mostly negligible (Davis, 1971), indicating they possess little efficacy as potential predictors. However, the demographic variable of age did have a moderate, negative correlation with both level of agreement with using food crops to make biodiesel (r = **-.**33) and agreement that biodiesel produces fewer exhaust emissions (r = **-**.37). This finding is consistent with the findings of Gronhoj and Thogersen (2009).

When interpreted through the lens of Ajzen & Fishbein's (1980) TRA, these consumers are highly uncertain about the consequences of biodiesel use (uncertain behavioral beliefs), do not have peer associations supportive of biodiesel use (lack of normative beliefs), and experience factors that would hinder use of biodiesel (negative control beliefs). Thus, despite their relatively high level of biodiesel awareness, these consumers are very unlikely to actually purchase or use biodiesel in the immediate future. Increased efforts to educate the public, in their roles as consumers and voters, about biodiesel are warranted.

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