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FRESH HAMMOCK-PACKED BARTLETT PEARS: IMPLICATIONS FOR MARKETING BASED ON CONSUMERS' WILLINGNESS TO PAY FOR SENSORY ATTRIBUTES AND RETURN ON INVESMENT POTENTIAL

By

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Major: Food & Resource Economics

The fresh fruit and vegetable industry in the United States has experienced significant change over the last few decades. As a result there are now more options than ever for consumers in terms of variety and availability. In spite of this change, the consumption of fresh pears in the United States has remained relatively stagnant over the last few decades (ERS, 2009). Consumers understand that eating fresh fruit leads to a balanced diet and a healthy lifestyle, however retail markets for fresh pears have not seen increased purchases. Greater access to fresh fruit such as pears and increased awareness of their health benefits has done little to increase consumption. Retailers face a great challenge in delivering higher quality, great-tasting fresh produce to the market. Ultimately, technology may be the answer to increasing consumption of fresh pears in the United States. Determining the attributes that consumers prefer in fresh pears will help supply chain participants deliver a better product to those markets.

Domestic producers also face challenges; greater competition in the marketplace due to various trade agreements, competitive advantage regarding production in other countries and energy costs effect producer's ability to provide quality produce while

maintaining profitable returns. Consequently, producers now seek to find ways to differentiate their product from the competition. Oftentimes differentiating fresh raw fruits and vegetables based on intrinsic, or physical, attributes is quite difficult. However, differentiating fresh raw fruits and vegetables based on extrinsic attributes may prove to be a viable means of adding value for producers and consumers alike.

The purpose of this study is composed of two parts:

1. To identify consumer preferences through sensory attributes for fresh Bartlett pears.
2. To determine the break-even price point for hammock pack technology and discover if it provides a positive return on investment for supply chain participants.

The consumer data in this study was obtained from voluntary participants in a sensory analysis panel conducted at the University of Florida during October 25th and 26th 2011. Financial data on the costs for manufacturing hammock pack containers were provided by FDS Manufacturing Inc. based out of Pomona, California. Other financial data were provided by industry members.

In this paper, we use a survey and conjoint analysis while asking participant's willingness to pay (WTP) for fresh raw Bartlett pears shipped in hammock packed containers versus those shipped in traditional bulk corrugated containers. We also asked participants to provide their responses to sensory attributes associated with Bartlett pears in two packaging forms, hammock and bulk, in order to understand consumers purchasing preferences.

INTRODUCTION

Purpose & Significance of Study

We are interested in determining the sensory attributes of fresh Bartlett pears for which consumers find most appealing in regards to appearance, aroma, acceptability, flavor and firmness. Understanding which of these attributes contribute the most to consumer WTP will help participants in the supply chain for fresh Bartlett pears ship a higher quality product that may increase consumption and sales. We are also interested in determining if the hammock package delivery system provides a positive return on investment for growers, shippers, wholesalers and retailers.

. The following research hypotheses were proposed in regards to the fresh pear supply chain in the United States.

Research Hypotheses

- Bartlett pears shipped in hammock packages are more protected than traditional bulk pears and consumers perceive this as being more protected and of higher quality in terms of taste, appearance and aroma.
- Consumers are willing to pay higher premiums for pears that are perceived to be more protected and of higher quality in terms of taste, appearance and aroma.
- Bartlett pears shipped in hammock packages yield a positive return on investment for producers, packers & shippers, wholesalers and retailers.

While our research hypotheses allow us to make certain assumptions, we must create testable objectives that either support or reject our theories. Given our research hypotheses, the goals of this study include the following four objectives:

Research Objectives

1. Determine consumer's preference for taste, appearance and aroma in fresh mature Bartlett pears.

2. Determine consumer's willingness to pay for fresh Bartlett pears in hammock packaged vs. traditionally shipped bulk containers.

3. Determine how changes in panel participant's sensory ratings of fresh Bartlett pears affect WTP.

4. Determine the break-even price utilizing hammock packaging in fresh Bartlett pears.

METHODOLOGY

There were four research objectives in this study. Objective 1 of this study was to determine consumer's preference for taste, appearance and aroma in fresh mature Bartlett pears in hammock packages versus those shipped in traditional bulk containers. Objective 2 was to determine consumer's WTP for fresh Bartlett pears in hammock packages vs. traditionally shipped bulk containers. Participants were asked to provide their subjective responses for quality attributes in order to understand consumer preferences in fresh Bartlett pears. After providing their responses, the participants were then asked to state their WTP for each of the samples.

Objective 3 was to determine how changes in panel participant's sensory ratings of fresh Bartlett pears affect WTP. Objective 4 was to determine the break-even price utilizing the hammock package system with fresh Bartlett pears. To accomplish objective 4, volume estimates for loading fresh Bartlett pears on a 53' refrigerated semi-tractor trailer with the maximum gross weight of 80,000 pounds were calculated for the half-slotted carton, as well as the 36, 40, & 44 pound volume filled boxes. The same was done for both a 2-layer corrugated Eurobox and reusable plastic container (RPC) with 8 hammock pack containers in each box and a Eurobox with wrapped pears tightly packed. A 3-layer RPC configuration with 12 hammock pack containers was also included in the volume estimates. With these estimates, given any freight weight, the

transportation and material costs can be calculated. Other costs such as labor and overhead can be used to determine the additional costs for utilizing hammock package containers in the supply chain. This information is also critical in determining the break-even unit price for hammock packaging in fresh Bartlett pears.

Sensory Panel

On October 25th, 2011 the sensory panel began with convenience sampling of participants. It was decided that the 12 pound firmness level pears were not ripe enough and were not used in the sensory panels. Treatment 3, which consisted of 6lb. pears, was the first to be studied on day 1 of the sensory panel. In total, 99 panelists participated on day 1 of the sensory panel. The questions asked were related to demographics, preferred sensory attributes and consumers' willingness to pay. The participants were compensated with a selection of either a discount coupon or soft drink of their choice. The day 2 sensory panel concluded the study with treatment 2. In treatment 2 hammock packaged pears and bulk pears at the 8 lb. firmness level were chosen for this experiment. In total, 88 panelists participated in day 2 trials and the same questions were used as in day 1.

Experimental Design

The two day sensory panel trial was conducted to identify preferred sensory quality characteristics and panel participant WTP for fresh Bartlett pears shipped in two packaging systems (hammock packs, bulk boxes). The consumer panel trial was conducted during October 25th and October 26th, 2012 at the University of Florida's Food Science & Human Nutrition Sensory Lab. Three replicate boxes of three firmness levels (12, 8 & 6 lbs.) were shipped containing pears in both hammock packs and tight-filled boxes during shipping trials. Two of the firmness levels (8 & 6 lbs.) were chosen

to determine consumers' preferred quality attributes for fresh Bartlett pears in a consumer panel.

Paired Comparison 1: Hammock Pack, Hammock Pears vs. Tray, Hammock Pears

In the first paired comparison, a 6-count hammock package of pears in the clamshell was placed in front of each panelist alongside a group of six pears removed the clamshell and placed on a serving tray. The pears were identical; however the packaging differentiated the two samples. Each sample was identified by a randomly generated blinding code known only by administers of the panel study and presented to each participant in alternating order. The participants were then asked to rate the two samples based on appearance only on a 9-point hedonic scale ranging from "Extremely Dislike" to "Extremely Like" and asked to state their preferred choice. They were then told that the current market price for bulk pears was $1.69/pound and asked to state their WTP for each sample.

Paired Comparison 2: Hammock Pack, Hammock Pears vs. Tray, Bulk Pears

The second paired comparison was similar to the first paired comparison. A 6-count hammock package of pears in the clamshell was placed in front of each panelist alongside a group of six pears from a traditional bulk 36-pound volume tight-fill box. These two samples of pears differed in how they were transported in the shipping trials. It is important to note that the hammock packed pears were shipped in a hammock pack clamshell while the bulk pears were shipped in the tight-fill container. As with the first paired comparison, each sample was identified by a randomly generated blinding code known only by administers of the panel study and presented to each participant in alternating order. The participants were then asked to rate the two samples based on appearance only on a 9-point hedonic scale ranging from "Extremely Dislike" to

“Extremely Like” and asked to state their preferred choice. They were then told that the current market price for bulk pears is $1.69/pound and asked to state their WTP for each sample.

Paired Comparison 3: Tray, Hammock Pears vs. Tray, Bulk Pears

Paired comparison 3 removed the hammock pack from the experiment and placed two pears, with one hammock and the other bulk, cut in half sample cups on a serving tray. This was done to remove the effect of the package on consumers’ preferred attributes and WTP. Participants were then asked to rate each individual sample on the same 9-point hedonic based on Appearance and Aroma only. The participants were then asked to taste and rate each individual sample based on Acceptability and Flavor. Similarly, participants were then asked to rate the firmness for each sample on a 5-point hedonic scale ranging from “Too Soft” to “Too Hard”. Rating the pears a score of 3 for firmness indicated that the participants believe the firmness of the pear was “Just About Right”. Finally participants were asked to state their WTP given the current market price of $1.69/pound for bulk pears.

WTP Model Specification

To determine how changes in WTP, occur as the rating of participant’s sensory attributes increase in fresh Bartlett pears, a full linear regression model was constructed. This model is based on the questions from both days of *Paired Comparison 3: Tray, Hammock Pears vs. Tray, Bulk Pears* of the sensory panel and do not include the appearance of a package to participants. In *Paired Comparison 3*, all packaging was removed from the participant’s view to determine if the hammock pack itself had an effect on participant’s WTP as an intervening variable. Treatment 3 pears

(6 lb. firmness level) were also categorized as a variable within the model to determine if the chosen objective firmness level acted as an intervening variable as well.

$$WTP_i = \beta_0 + \beta_1 Appearance_i + \beta_2 Aroma_i + \beta_3 Acceptability_i + \beta_4 Flavor_i + \beta_5 Firmness_i + \beta_6 Treat3_i + \beta_7 Package_i + \varepsilon_i$$

Full WTP Multiple Regression Model

Where *i*=1,…, *n* denotes the *i*th individual; Appearance, Aroma, Acceptability, Flavor and Firmness are the individuals *i*'s ratings for the pears' attributes. The hammock pack and Treatment 3 pears were assigned a dummy variable in the model where 1=variable present and 0=variable absent The β's are the unknown parameters of the model to be estimated and ε_i is the observed error.

We estimate the model using a robust regression procedure with the SAS statistical package and determine if the coefficients are statistically significant. The robust regression procedure was used due to a strong suspicion of heteroscedasticity and due to the presence of outliers. We then test the dummy variables Treat3 and Package for overall significance by conducting a hypothesis test using an F-test and making a decision using the critical value approach.

Return on Investment

One of the purposes of this study was to determine the break-even price point for hammock pack technology and discover if it provides a positive return on investment for supply chain participants. Currently, our data is incomplete although we expect it soon, however due to deadlines we must submit our paper as such. As soon as the data is received, we will be re-submitting a completed version of this paper with our findings.

Once we have the data, we will able to use these estimates to determine the costs associated with hammock packaged fresh Bartlett pears on a per pound basis for

different packing configurations. We can then determine the costs for transportation, materials and labor on a per pound and even per unit basis. We will then compare the per pound estimates to the differences of the stated WTP by participants of the sensory and the market price per pound for fresh Bartlett pears at the time of the sensory panel. This will help us determine if hammock packed pears have the potential to provide a positive return on investment in the fresh pear supply chain.

RESULTS

The results of this study are divided into three main sections. First the results of the sensory panel are presented including participant's ratings, stated WTP based on appearance, preferred choice and demographic information. The second section discusses the results of the WTP linear robust regression model where the package was removed in order to determine how changes in sensory attributes of fresh Bartlett pears affect WTP. The third and final section of this chapter analyzes estimates for return on investment, break-even price, and comments on the overall economic feasibility of hammock package system in the fresh pear supply.

Sensory Panel Results

Paired Comparison 1: Hammock Pack, Hammock Pears vs. Tray, Hammock Pears

The results for the first paired comparison of hammock pack, hammock pears vs. tray, hammock pears based on appearance only for day 1 and day 2 participant's responses show that participants prefer the hammock pack, hammock pears. A mean of 6.43 was stated for hammock pears in the hammock pack as opposed to a mean of 4.86 for hammock pears presented on a serving tray despite the 6 lb. firmness level

pears being identical on day 1. On day 2, participants gave a rating of 6.43 for hammock pears in hammock packs while bulk pears received a rating of 4.67 for the 8 lb. firmness level pears. There were statistically significant differences in these stated mean values for both Days 1 and 2. These figures are based on a 9-point hedonic scale ranging from 1 equaling Dislike Extremely and 9 equaling Like Extremely.

It is clear that although the pears are identical in every way except the packaging they are presented in, participant's rate the hammock pears in the hammock pack significantly higher than the hammock pears removed from the packaging and presented as if they were a bulk pear. This suggests that consumers may prefer the hammock package design over that of a traditional loose bulk pear whenever the product is displayed and sold at various retail store locations.

Descriptive Statistics of Pear Appearance Ratings in Paired Comparison 1

	Day 1 - Treatment 3 - 6 lbs.		***Day 2 - Treatment 2 - 8 lbs.***	
	Hammock Pack, Hammock Pears	*Tray, Hammock Pears*	*Hammock Pack, Hammock Pears*	*Tray, Hammock Pears*
Mean	6.43***	4.86***	6.43***	4.67***
Standard Error	0.12	0.17	0.16	0.19
Median	7.00	5.00	7.00	4.50
Mode	7.00	4.00	7.00	4.00
Standard Deviation	1.20	1.65	1.49	1.77
Sample Variance	1.43	2.71	2.23	3.12

Note: (*, **, ***) represent statistical significance at the 10%, 5% and 1% levels, respectively.

On day 1, 86% prefer hammock pack, hammock pears while 14% prefer tray, hammock pears while 90% prefer hammock pack, hammock pears on day 2. Given the statistically significant difference between both samples, the preferred choice between the two should not be surprising. Participants rated the pears packaged in the

hammock system higher than those simply placed on a tray, therefore it is only natural they would prefer them as well.

The mean WTP for appearance in the first paired comparison for *Hammock Pack, Hammock Pears vs. Tray, Hammock Pears* was $1.77 and $1.46 respectively on day 1. Hammock pack, hammock pears and tray, hammock pears had mean values of $1.66/lb. and $1.22/lb. respectively for day 2. A two sample t-test assuming equal variance was conducted to determine if the difference was statistically significant. Day 1 results showed a statistically significant difference between hammock pears in the hammock pack verses hammock pears removed from the hammock pack at α=0.10, 0.05 & 0.01 levels. Again, this was to be expected as participants rated pears in the hammock pack higher than those simply placed on a tray as it would appear in a retail location. While a statistically significant difference doesn't necessarily imply meaningfulness or importance, it does provide an answer about whether these results could have happened by chance. In this case, participants express an interest in paying a price premium above the market price for 6 lb. firmness level pears on day 1, therefore it is unlikely that this is coincidence and this may have implications for actual sales. In both treatments participants discounted the amount they were WTP for bulk pears based simply on the appearance of the pears on trays.

WTP ($/lb.) for Appearance Hammock Pack, Hammock Pears vs. Tray, Hammock Pears

	Day 1 - Treatment 3 - 6 lbs.		***Day 2 - Treatment 2 - 8 lbs.***	
	Hammock Pack, Hammock Pears	*Tray, Hammock Pears*	*Hammock Pack, Hammock Pears*	*Tray, Hammock Pears*
Mean	$1.77***	$1.46***	$1.66***	$1.22***
Standard Error	0.08	0.08	0.07	0.05
Median	$1.69	$1.40	$1.67	$1.22
Mode	$1.69	$1.69	$1.69	$1.00
Standard Deviation	0.83	0.76	0.66	0.47
Sample Variance	0.69	0.58	0.43	0.22

Note: (*, **, ***) represent statistical significance at the 10%, 5% and 1% levels, respectively.

Paired Comparison 2: Hammock Pack, Hammock Pears vs. Tray, Bulk Pears

The results for the second paired comparison of *Hammock Pack, Hammock Pears vs. Tray, Bulk Pears* based on appearance only provide descriptive statistics for day 1 and day 2. Similar to the results in *Paired Comparison 1*, participants rated the *Hammock Pack, Hammock Pears* higher than the *Tray, Bulk Pears* on days 1 and 2. It is interesting to note that the *Tray, Bulk Pears* scored 1 scale point lower than the *Tray, Hammock Pears* while *Hammock Pack, Hammock Pears* were scored nearly the same in both Paired Comparison 1 and Paired Comparison 2. This should be expected since the *Hammock Pack, Hammock Pears* samples were identical in both comparisons. On day 1, a mean of 6.39 was stated for *Hammock Pack, Hammock Pears* as opposed to a mean of 3.85 for *Tray, Bulk Pears*. Day 2 mean results were 6.52 and 3.65 for *Hammock Pack, Hammock Pears* and *Tray, Bulk Pears* respectively. The differences in the mean responses for each sample were statistically significant at α=0.10, 0.05 and 0.01 levels for days 1 and 2.

Appearance Descriptive Statistics Paired Comparison 2 Pears.

	Day 1 - Treatment 3 - 6 lbs.		***Day 2 - Treatment 2 - 8 lbs.***	
	Hammock Pack, Hammock Pear	*Tray, Bulk Pear*	*Hammock Pack, Hammock Pear*	*Tray, Bulk Pear*
Mean	6.39***	3.85***	6.52***	3.65***
Standard Error	0.13	0.19	0.15	0.17
Median	7.00	4.00	7.00	3.50
Mode	7.00	2.00	7.00	4.00
Standard Deviation	1.26	1.89	1.42	1.57
Sample Variance	1.59	3.58	2.02	2.46

Note: (*,**,***) represent statistical significance at the 10%,5% and 1% levels, respectively

On Day 1 94% preferred *Hammock Pack, Hammock Pears* while 6% prefer *Tray, Bulk Pears* whereas 95% prefer *Hammock Pack, Hammock Pears* and 5% preferred *Tray, Bulk Pears* on Day 2.

The mean WTP based on appearance only in the second paired comparison for *Hammock Pack, Hammock Pears* and *Tray, Bulk Pears* was $1.77 and $1.13 respectively on Day 1. *Hammock pack, Hammock Pears* and *Tray, Bulk Pears* had mean values of $1.65 and $1.01 respectively for Day 2. There was a statistically significant difference between the *Hammock Pack, Hammock Pears* and the *Tray, Bulk Pears* on days 1 and 2 at α=0.10, 0.05 and 0.01 levels.

WTP for Package Appearance Hammock Pack, Hammock Pears vs. Tray, Bulk Pears

	Day 1 - Treatment 3 - 6 lbs.		***Day 2 - Treatment 2 - 8 lbs.***	
	Hammock Pack, Hammock Pears	*Tray, Bulk Pears*	*Hammock Pack, Hammock Pears*	*Tray, Bulk Pears*
Mean	$1.77***	$1.13***	$1.65***	$1.01***
Standard Error	0.09	0.07	0.07	0.06
Median	$1.69	$1.00	$1.67	$1.00
Mode	$1.69	$1.00	$1.69	$1.69
Standard Deviation	0.85	0.69	0.66	0.59
Sample Variance	0.72	0.47	0.43	0.35

Note: (*,**,***) represent statistical significance at the 10%,5% and 1% levels, respectively

Paired Comparison 3: Tray, Hammock Pears vs. Tray, Bulk Pears

On day 1 the *Tray, Hammock Pears* had means of 6.90, 7.03, 6.72 and 6.65 for Appearance, Aroma, Acceptability and Flavor while *Tray, Bulk Pears* had means of 6.04, 6.65, 6.54 & 6.68 in the same respective categories. There was a statistically significant difference between the means of both samples of pears in regards to Appearance at α=0.10, 0.05 and 0.01 levels. Aroma expressed a statistically significant difference between the means of the samples at α=0.10 and 0.05. A statistically significant difference between both samples in Appearance and Aroma may suggest that the hammock package system is effective at delivering better looking, more aromatic fruit.

Day 1 Paired Comparison 3 Mean Responses.

Day 1 Paired Comparison 3 Mean Responses

	Tray, Hammock Pears	Tray, Bulk Pears
Appearance	6.90***	6.04***
Aroma	7.03**	6.65**
Acceptability	6.72	6.54
Flavor	6.65	6.68

Note: (*,**,***) represent statistical significance at the 10%,5% and 1% levels, respectively

Day 1 Hammock Pack Pears Response Attributes

While there were no statistically significant differences in the means of Acceptability and Flavor, the distributions of all categories were more normally distributed with less variation in the responses in the *Tray, Hammock Pears* than the *Tray, Bulk Pears*. Less variation in the sensory attributes, despite the absence of the hammock packaging, suggests that the hammock package system produces less variability in the quality of the fruit. This implies that the hammock package system can

deliver and more consistent product throughout the supply chain, leading to consumer satisfaction as well as increased and repeat sales.

Means of 2.58 and 2.65 were stated for *Tray, Hammock Pears* and *Tray, Bulk Pears* respectively, however on Day 1, there were no statistical differences between the participant's ratings of the two samples. On Day 1 50% of the participants stated that the *Tray, Hammock Pears* were rated a 3 or "Just About Right" where a rating of 1 represents pears that are "Too Soft" while a rating of 5 represents pears that are "Too Hard". Of the 99 participants on Day 1, 13%, 27% 9% and 1% stated the *Tray, Hammock Pears* were "Too Soft", "Slightly Too Soft", "Slightly Too Hard" and "Too Hard" respectively. 53% of the *Tray, Bulk Pears* were rated as "Just About Right" while 10%, 26%, and 11% were rated as "Too Soft", "Slightly Too Soft" and "Slightly Too Hard" respectively. There was no statistical difference in the ratings provided by the participants based on the firmness of both samples of pears. This suggests that at the 6 lb. firmness level, the hammock package system may be equally effective at delivering fresh pears to consumers as traditional shipping methods.

There was no statistically significant difference in mean WTP for preferred quality attributes in the *Tray, Hammock Pears* and the *Tray, Bulk Pears*. The mean WTP for both samples was $1.50/lb, although there was slightly more variability in the participants responses for bulk pears. The similarity in these mean WTP responses was to be expected because the hammock package system was removed from the participants view as to not intentionally influence their WTP. At the time of the sensory trials, participants were told the current market price for pears was $1.69/lb. This was the current market price/lb. for fresh Bartlett pears at the retail level during the week of

October 23rd, 2011 in Gainesville, Florida. Interestingly, not only did the participant's state identical mean values for both hammock pears and bulk pears, but they also discounted both samples relative to the $1.69/lb. market price that was prevalent at the time. This suggests that consumers may place price premiums on ready-to-eat fresh pears that are prepackaged for sale. Further in-store testing of this observation at various price points will be required in order to confirm this statement.

Day 1 WTP for Sensory Attributes

Day 1 Willingness to Pay Descriptive Statistics

	Tray, Hammock Pears	Tray, Bulk Pears
Mean	$1.50	$1.50
Standard Error	0.054	0.058
Median	$1.50	$1.59
Mode	$1.69	$1.69
Standard Deviation	0.540	0.576
Sample Variance	0.291	0.332

Participants like the hammock pack pears; however bulk pears were rated higher on Appearance, Acceptability and l Flavor. The mean responses for hammock packs in the categories of Appearance, Aroma, Acceptability and Flavor were 6.02, 6.93 6.65 & 6.35 and for bulk were 6.67, 6.88, 6.81 & 6.62. However, only Appearance showed statistically significant difference between the mean responses for hammock pears and bulk pears. In the case of Appearance, it is unknown why participants prefer the bulk pears over the hammock pears. Perhaps the hammock package system is not appropriate for use in firmness levels at or above the 8 lb. firmness level. More research into this matter would be appropriate however this may in fact suggest that, at the 8 lb. firmness level, consumers cannot identify any distinguishable characteristic

that entices them to rate hammock pears higher than bulk pears and thus ultimately pay a price premium. The main assumption being that higher responses to sensory attributes leads to higher a WTP by participants which may represent premiums paid by consumers at the retail level.

Day 2 Paired Comparison Mean Responses

Day 2 Paired Comparison 3 Mean Responses

	Tray, Hammock Pears	Tray, Bulk Pears
Appearance	6.02***	6.67***
Aroma	6.93	6.88
Acceptability	6.65	6.81
Flavor	6.35	6.62

Note: (*,**,***) represent statistical significance at the 10%,5% and 1% levels, respectively

On Day 2, respondents tended to prefer the firmness of the *Tray, Bulk Pears* to that of *Tray, Hammock Pears*. 88 respondents stated the firmness of the *Tray, Bulk Pears* was “Just About Right”. 64% of the participants felt that the 8 lb. *Tray, Bulk Pears* were “Just About Right”. This is in contrast to 42 of the 88 respondents which stated the *Tray, Hammock Pears* were “Just About Right”, or approximately 48% of the sample survey. The mean firmness values for *Tray, Hammock Pears* and *Tray, Bulk Pears* on a 5-point hedonic scale were 2.47 and 2.80 respectively and there was a statistically significant difference between these values. Perhaps the hammock pack system provides too much protection or inhibits further desirable ripening of the fruit at higher firmness levels, rendering it unnecessary.

There was a difference in mean willingness to pay for preferred quality attributes of the *Tray, Hammock Pears* and *Tray, Bulk Pears* of $0.09/lb. in favor of bulk; however there were no statistical difference between the two samples. The mean WTP for *Tray,*

Hammock Pears was $1.44/lb. while participants stated a mean of $1.53/lb. for *Tray, Bulk Pears*. As before, at the time of the sensory trials, participants were told the current market price for pears was $1.69/lb.

Day 2 WTP for Sensory Attributes

Day 2 Willingness to Pay Descriptive Statistics

	Tray, Hammock Pears	Tray, Bulk Pears
Mean	$1.44	$1.53
Standard Error	0.065	0.071
Median	$1.50	$1.53
Mode	$1.69	$1.69
Standard Deviation	0.610	0.662
Sample Variance	0.372	0.438

WTP Model Estimation Results

A linear regression model was estimated using the robust regression procedure with the SAS statistical package. The coefficients for Appearance, Aroma, Acceptability, Flavor, Firmness, Treat3 and Package were 0.0151, 0.007, 0.0675, 0.0746, 0.0487, 0.0208 and -0.0043 respectively. The coefficients show the change in WTP, as measured in $/lb., for each respective variable as the participants rating increase by one rank in the hedonic scale. Further testing was necessary to determine overall significance of the dummy variable coefficients for Treat3 and Package. Therefore the following hypothesis was constructed:

$$\boldsymbol{H_0: \beta_6 = \beta_7 = 0}$$

$$\boldsymbol{H_a: \beta_6 \neq \beta_7 \neq 0}$$

To test whether the parameters for Treat3 and Package are not equal to zero simultaneously, the following F-test was conducted such that the F-statistic:

$$\boldsymbol{F = \frac{(SSR_R - SSR_{UR})q}{SSR_{UR}/n - (k+1)}}$$

Formula for F-Statistic

Where SSR_R is the sum of the squared residuals for the restricted model (the removal of Treat3 and Package variables), SSR_{UR} is the sum of the squared residuals for the unrestricted model (the full WTP linear regression model), *q* is the number of restrictions (2), *n* is the number of observations (374), *k* is the number of independent variables in the unrestricted model (7). After computing the F-statistic and using the critical value approach, we fail to reject the null hypothesis that the coefficients for Treat3 and Package are equal to zero. Therefore, as intervening variables, Treat3 and Package are assumed to have no effect on participant's WTP.

WTP Linear Regression Model for Sensory Attributes

	WTP Linear Regression Model	
Variable	Parameter	p-value
Intercept	0.2385*	0.0334
Appearance	0.0151	0.2282
Aroma	0.007	0.6458
Acceptability	0.0675*	0.0026
Flavor	0.0746*	0.0001
Firmness	0.0487*	0.0473
Treatment	0.0208	0.5489
Package	-0.0043	0.9012
R-Square	**0.1972**	

Note: * Represents statistical significance at the 5% level.

It was also necessary to determine if the conditional variance of WTP, given our sensory variables, changes with time. Another words, we must determine if heteroscedasticity was present in the model. A White test was run to determine if heteroscedasticity was present in the model, however results indicated no presence.

The WTP Linear Regression Model yielded a coefficient of determination of 0.1972. Therefore 19.72% of the variation in WTP can be explained by the variation in the participants' sensory responses. The "goodness of fit" in this model may appear rather low; however a low coefficient of determination for cross-sectional data is quite common. Nevertheless, the model provides insight into which sensory characteristics contribute to consumer WTP and whether the Package and Treat3 variables act as intervening variables. Ultimately, based on the sensory attributes of the pears themselves and removing the hammock packaging, Acceptability, Flavor and Firmness are statistically significant at increasing WTP as participants increase their ratings in fresh Bartlett pears.

Summary & Conclusions

Marketing and health awareness campaigns seem to have done little to increase consumption. New technologies such as the hammock package system for produce such as fresh Bartlett pears may have a positive impact on consumption and demand throughout the supply chain. Hammock package technology allows ready-to-eat fruit such as pears to be transported throughout the supply chain with less damage than fruit shipped in bulk containers at the same firmness level. This new technology is proving to be a viable alternative to the traditional systems.

The first part of this study was to the determine the sensory attributes in fresh Bartlett pears that consumers find most appealing in regards to appearance, aroma, acceptability, flavor and firmness. Also, knowing which of these attributes contribute to consumer WTP will help participants in the supply chain for fresh Bartlett pears ship a higher quality product that may increase consumption and sales. This study also

sought to determine if the hammock pack delivery system provided a positive return on investment for growers, shippers, wholesalers and retailers. Ultimately, this study provides insight for fresh pear supply chain participants in regards to what attributes consumers find most appealing. Eventually, it will provide insight as to whether hammock pack technology will offer a positive return on investment.

As shown in the results of the sensory panel study, the participants rated the appearance of 6 lb. and 8 lb. firmness level pears packaged in a hammock pack container higher than those displayed loosely, as seen in most retail settings. This was true regardless if the pears were from a bulk container or if they were simply removed from a hammock package. The participants also stated a higher WTP for fresh pears packed in the hammock pack container than those loosely displayed on the tray. At the 6 lb. firmness level, participants were WTP a premium of $0.08/lb. for fresh Bartlett pears packed in the hammock pack container; however at the 8 lb. firmness level, participants were unwilling to pay a premium on average. When asked which sample they preferred, based on appearance only, on average over 91% of the respondents chose the pears packaged in the hammock pack container over those displayed loosely. This was true regardless of the firmness of the pears. .

Using the robust regression procedure in the SAS statistical software package, the coefficients for Appearance, Aroma, Acceptability, Flavor, Firmness, Treat3 and Package were .0151, 0.007, 0.0675, 0.0746, 0.0487, 0.0208 and -0.0043 respectively. Therefore, as the respondents' hedonic ratings increased by 1, their WTP increased by the amount of the coefficient in their respective categories by holding all other categories constant. Based on the estimates for the model, Acceptability, Flavor and

Firmness were statistically significant at α=0.05. A hypothesis test was created to determine overall significance of the Treat3 and Package variables. It was determined that Treat3 and Package variables have little if any effect on consumer WTP. The coefficient of determination for our regression model was .1972. It is interpreted as the percent of variation in WTP for fresh Bartlett pears that can be explained by the variation of the sensory attributes and dummy variables chosen as the indepdent variables in the model.

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