MIDWERSTERNS' CONSUMER PREFERENCE FOR GOAT MEAT IN A BLIND SENSORY ANALYSIS

By

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MIDWESTERNERS' CONSUMER

PREFERENCE FOR GOAT MEAT IN

A BLIND SENSORY ANALYSIS

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Abstract:

Goat meat is commonly eaten around the world, though only rarely by Americans, and it is unclear whether this is due to its taste or some other reason. A blind sensory analysis was performed to determine U.S. consumers' preference is for goat meat compared to beef and pork. Goat shoulder, beef brisket, and pork shoulder were all slow cooked and shredded, and a group of consumers in the State of Oklahoma rated each meat using a nine-point hedonic scale in four categories. Logit modeling revealed goat, beef, and pork all received similar favorable ratings from participants, though pork and beef were slightly favored to goat. These results demonstrate why Americans consume more beef and pork than goat, but does not explain why goat is consumed so seldom.

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CHAPTER I

INTRODUCTION

Goat is among the most widely consumed livestock in the world, with much of the population eating goat meat as part of their regular diet (Biswas et al. 2007). This may come as a surprise to Americans because goat meat is rarely included in their standard Friday night dinner. When Americans consume meat it usually consist of beef, pork, or poultry. While goat is not favored in western countries it is popular among developing countries, making up 90% of the goats worldwide (Webb et al., 2005). Even in developing countries however, goat is sometimes seen as a poor man's food, and raising or eating goat signifies a lack of success (Dubeuf et al, 2004), (Morand-Fehr et al. 2004). Nonetheless, more people are consuming goats than ever before, (Food and Agriculture Organization of the United Nations, 2015) and as goat production continues to rise and Americans seek to diversify its agricultural production, goat may deserve a second look.

Meat goat production was, in 2012, said to be the most rapidly expanding animal enterprise in the country (Jones, McCarter, Cheney, 2015). Slaughter of goats in federally inspected facilities has risen from just over 200,000 head in 1988 to over 600,000 today (NASS, 2011). The rise in goat production was exceeded by consumption increases, as the U.S. became a net importer of goat in 1991(Sande, Houston, Epperson, 2005). The number of imports since then has risen from 1,749 metric tons to 15,752 metric tons in 2011 (Stanton, 2012). This rise in

demand has been attributed to changes in (1) A more ethnically diverse America (2) keener interest in health foods and (3) interest in goat from a culinary perspective (Sande, Houston, Epperson, 2005). Although the rise in goat demand is good for the goat industry, it could rise much further if the average American began eating goat. The Center for Disease Control and Prevention interviewed 65,536 individuals regarding their food consumption, asking them to keep a food journal for two days out of the year, but only seven out of the 65,356 people ate any goat during those two days. Not only is goat seldom consumed, it does not have a good reputation among Americans. Knight et al. (2005) found in a telephone survey that over 50% of individuals were unwilling to even try goat meat, and that people perceive the meat as inexpensive but inconvenient.

It is unclear why goat meat is absent from most kitchen tables and restaurants: is it a supply or demand issue, or both? There is some evidence it is the taste of goat meat that keeps demand low, but some of the evidence is decades ago, whereas consumers now seem more adventurous in their food consumption, and few recent evaluations have been conducted. Moreover, limited evidence exists on the likeability of different attributes of goat meat. To further investigate the role of taste in goat meat's minor role in American food consumption, this study conducts a sensory analysis of shredded goat shoulder meat to (1) determine individuals' overall satisfaction of goat meat compared to pork and beef (2) evaluate the distinctness of goat meat compared to pork and beef and (3) study how the flavor, juiciness, and tenderness of goat meat contributes to its overall likeability.

CHAPTER II

MATERIALS AND METHODS

To determine how people rate their eating experiences between goat, pork, and beef, a blind sensory analysis was conducted. The goats were acquired by the Sheep and Goat center at Oklahoma State University, butchered at a live weight of around 100 lbs, and processed and prepared by a federally inspected facility. All were Boer meat goat breeds, and although meat from the entire carcass was cooked only shredded meat from the goat shoulder was used in the sensory analysis.

To compare the sensory attributes of goat relative to two other common meats, pork shoulders and beef briskets were acquired from a nearby supplier. The pork and beef were seasoned, cooked, and shredded identically to the goat, and each were cooked intact and only shredded after cooking. All three meats were seasoned liberally with Legg's Old Plantation Seasoning Prime Rib Rub. The meats were then cooked in the same cooker/ smoker in FAPC as follows: cooked 160°F (dry bulb temperature) for one hour, smoked at 170 °F for two hours, and then cooked at 190 °F for four hours. As can be seen in Figure 1, the three meats seem to be similar in their final texture and appearance. A sensory analysis was designed to measure the tenderness, juiciness, flavor, and overall eating experience of the three meats by non-trained panels of Midwestern consumers. The analysis was conducted at two locations in order to acquire an adult and student sample. The first location was at a local precision agriculture software business in Stillwater, OK and the other allocation was a student social gathering on the

Oklahoma State campus. Both of the experiments provided the participants with a free meal in exchange for partaking in the survey. Respondents from the two locations will be referred to as adults and students.

Figure 1 Overview of sensory experiment

Table 1 shows the overall demographics of the participants. The student set contains 57 observations and is made up of almost equal amounts of males (51.9%) and females with an average age of 22 years old. The adult sample is heavily dominated by males, making up over 75% of the observations, and is about thirteen years older than the students. Although the samples differed in many ways, both groups consume goat only rarely but pork and beef frequently.

	Student(N=57)	*Adult(N=31)*
Male (%)	51.9%	80.6%
Age (average)	22	35
Consumes the meat occasionally or frequently:		
Goat	(1.9%)	(3.2%)
Beef	(100%)	(96.8%)
Pork	(89.9%)	(87.1%)
Chicken	(98.1%)	(100%)
Wildlife	(33.3%)	(35.5%)
% Who agree that meat is:		
Humanely Raised	81.5%	83.9%
Easy Food Poison Carrier	53.7%	61.3%
Tasty	96.3%	100%
Environmentally Friendly	90.7%	74.2%
Reasonably Priced	63.0%	19.4%
Healthy	98.1%	90.3%

Table 1 Summary statistics of all participants

II.1 Blind Sensory Analysis

The objective of this study is to determine how people rate their satisfaction of goat meat compared to pork and beef. Asking consumers directly about their preferences for goat is problematic because only a minority of people have consumed goat and it may have an unwarranted reputation that influences the meat flavor. Participants must be allowed to tastes the three different meats without knowing the identities to allow their choice to measure goat meat's true experience attributes. This was accomplished by assigning each meat into individual cups labeled only as square, circle, or triangle, as shown in Figure 1. Additionally, participants were provided water and unsalted crackers to cleanse their palate before tasting each meat.

The meat associated with each shape was randomized across respondents. Each survey had the name of a color printed at the top that correlated with the color of the shapes on the person's three meat cups. For example, the survey corresponding to Figure 1 had the word 'GREEN' printed at the top, which meant that goat was in the triangle container. For the color 'RED' it was in the circle container and for the color 'BLUE' it was in the square.

The questionnaire (shown in Appendix A) asked subjects to indicate the extent to which they liked the tenderness, flavor, juiciness, and overall satisfaction of each meat. The standard 9-point hedonic scale shown in Figure 2 was used (Stone, Bleibaum, and Thomas, 2012), and the questionnaire reminded the subject to eat a saltine cracker and take a sip of water between each meat.

Please indicate the extent to which you like or dislike the tenderness, flavor, juiciness, and overall satisfaction of the meat labeled **Square**.

		Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely
Square	**Tenderness**	○	○	○	○	○	○	○	○	○
	Flavor	○	○	○	○	○	○	○	○	○
	Juiciness	○	○	○	○	○	○	○	○	○
	Satisfaction with overall eating quality	○	○	○	○	○	○	○	○	○

Figure 2 Hedonic scale from participants' survey

II.2 Hedonics

After ranking each meat according to these four attributes participants were asked to rank the three meats (identified only by shapes) corresponding to which was their favorite, where 1 = most favorite (Figure 3). This forces individuals to indicate a preferred meat even if they gave two, or even all three, meats identical ratings on the hedonic scale. The order in which the three shapes were listed was randomized across each questionnaire. The survey asked a number of demographic questions in addition to how often the participant consumed a variety of different meats.

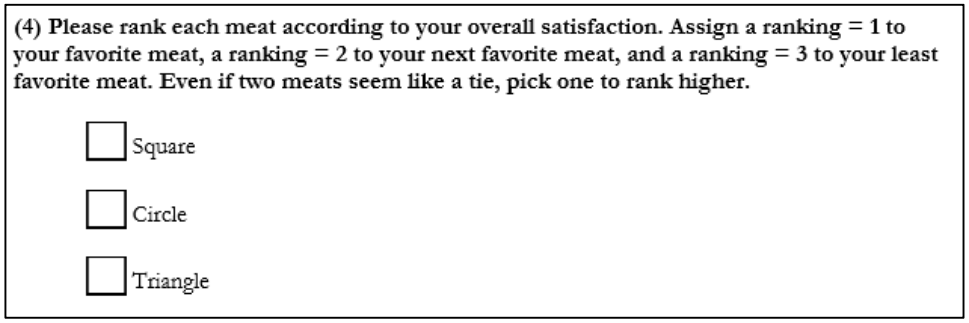


Figure 3 Ranking question from participants' survey

In order to determine which meats were preferred in terms of the four categories the questionnaire asked about, tenderness, flavor, juiciness, and overall satisfaction, we conducted a simple sign test. It is important to note that the sign test is non-parametric, meaning that it has very few assumptions about the nature of the distribution of the test. We paired goat to pork, goat to beef, and finally, beef to pork. The combined observations may be labeled *x* and *y*. The comparisons only have three possible outcomes, x>y, x=y, and x<y. We will be using the sign test to test the hypothesis that the difference concerning the x and y have no midpoint. We will be testing this by letting $p = \Pr(X > Y)$ and then test the null hypothesis, H0: $p=0.50$. Simply put, the null hypothesis says that given a random set of values (*x, y*) it is equally possible for *x* and *y* to be larger than the other.

II.3 Ranking

The average ranking of the student and adult populations were found by taking the average ranking of each meat: goat, beef, and pork. When asked to rank the meats each respondent was to assign a unique ranking of 1 to their favorite meat and a 3 to their least favorite meat. However to make the rankings and graph more easily understood we reversed the rankings so that 1 is now the least favorite meat and 3 is the favorite meat. After that, we analyzed the average ranking to determine which meat is favored by the students and adults.

To analyze how demographics and eating habits influence the meat rankings, the ranking data are also analyzed using the rank ordered logit regression in the program STATA. This model

assumes that the overall utility or satisfaction from any one meat can be described by the random utility model in (1), where each respondent, i, has a certain utility, U_{ij}, for every choice, j, where j spreads from 1 to the total number of items and V_{ij} represents the systematic component. The random component, ε_{ij}, is assumed to follow a Type II Extreme Value Distribution. The size of j is three, to denote the alternatives goat, beef, and pork.

$$(1)\ U_{ij} = V_{ij} + \varepsilon_{ij} = \beta_1(BEEF_{ij}) + \beta_2(PORK_{ij}) + \varepsilon_{ij}$$

The systematic portion of utility V_{ij} is set equal to the equation $\beta_1(BEEF_{ij}) + \beta_2(PORK_{ij})$, where *BEEF* = 1 if the meat being evaluated is beef; otherwise it equals zero. Likewise, *PORK* = 1 if it is pork and if it is not then *PORK* = 0. Thus, if the meat being considered is goat then *BEEF* = *PORK* = 0 and the systematic utility is normalized to equal zero. The coefficients β_1 and β_2 are coefficients to be estimated using maximum likelihood. The sign and statistical significance of the coefficients β_1 and β_2 describe the ranking of beef and pork, respectively, relative to goat. For example, if β_1 is positive then beef tends to be ranked higher than goat, on average.

CHAPTER III

RESULTS

A total of 88 individuals participated in the sensory analysis, thus producing 264 choice observations, however some of these observations were excluded. Respondents who answered in an incorrect format, such as ranking only one of the three meats and leaving the other two blank, were omitted from the final analysis. Additionally, individuals who did not specify important demographic information, such as their age or frequency of goat consumption were similarly removed.

After the extraction of incomplete responses, a total of 81 individuals remained. The majority of these participants answered all the sensory questions in a suitable manner, leading to a total of 240 observations. Table 1 outlines the characteristics of the final group of individuals. The data was then imported into STATA analysis, and the script used is provided in Appendix C.

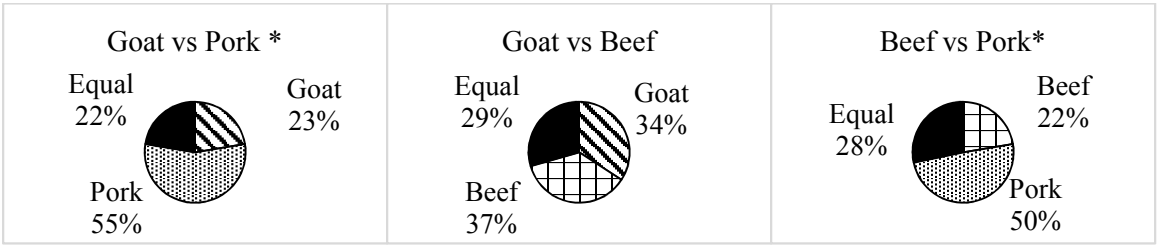
III.1 Hedonics

First, we analyzed the sensory data using the simple sign test—a nonparametric test that considers the percent of instances where one meat receives a higher ranking than a second meat, without considering the magnitude in differences between the two options (see Figure 4). It tests whether one meat receives a higher rating than the other meat more than 50% of the time, for all

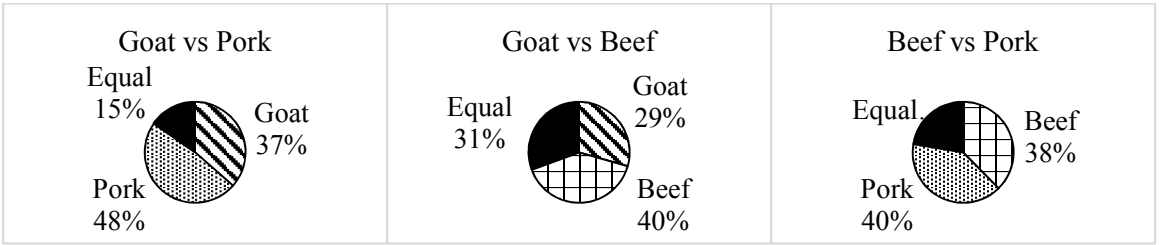
cases where the ratings are not equal (Dixon and Mood, 1946). If one meat does receive higher ratings in more than 50% of these cases, it is said to have a higher rating, for the average subject. A nonparametric test has the advantage that it makes no assumption regarding the distribution of the hedonic ratings.

Meat Preference in terms of:

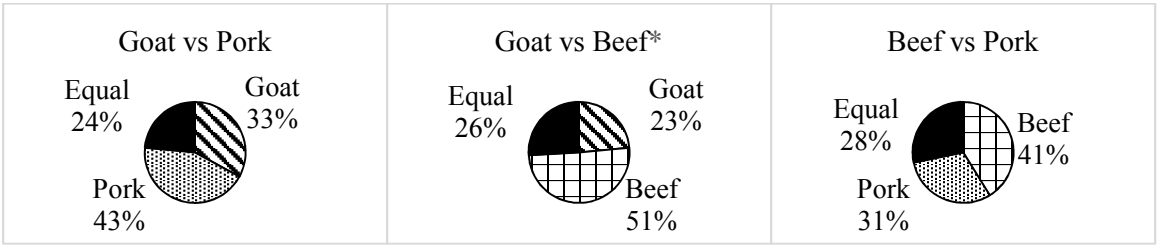
Tenderness



Flavor



Juiciness



Overall

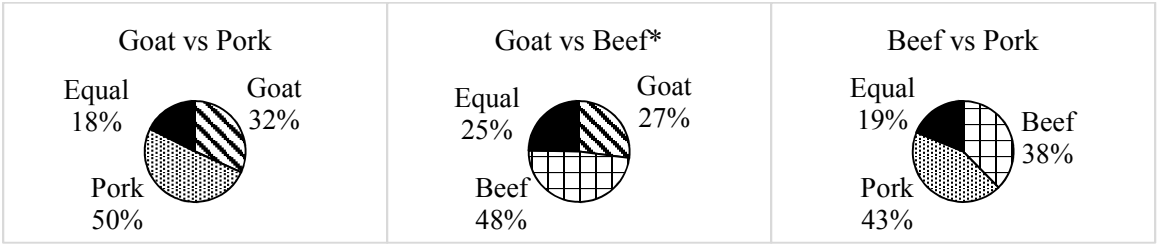


*Figure 4 Sign test results *statistically significant using the sign test at 95% confidence level*

Figure 4 shows the percent of times an attribute for one of the meats was rated higher, lower, or equal to the attribute for the other two meats. Consider the first pie chart in the top-left. This shows that 55% of the time the tenderness of pork was preferred to the tenderness of goat, 23% percent of the time the opposite occurred, and 22% of the time both received equal hedonic scores for tenderness. As indicated in the figure, the sign test shows that for those cases where one meat was rated higher, more than 50% pork received the higher rating. This doesn't prove that pork is tenderer than goat, but it does suggest that consumers like the tenderness attribute of pork above that of goat. Move one pie chart to the right, and it shows that 37% of people preferred the tenderness of beef to that of goat, with 29% rating them equal. These numbers suggest that consumers like the tenderness of goat and beef the same, and the sign-test confirms this.

As shown in Figure 4, the tenderness, flavor, juiciness, and overall satisfaction of pork was consistently favored to goat; and with the exception of juiciness, pork was also preferred to beef. However, in only a few instances the differences were statistically significant. Taking into account the sign-test we can only say that pork has a higher tenderness rating than goat, beef has a higher juiciness and overall satisfaction than goat, and pork has a higher tenderness rating than goat. Roughly one-third of individuals rated goat higher than pork and beef overall, so goat does appeal to a considerable number of people. Nonetheless, in every comparison and every attribute beef and pork were rated higher than goat. Still, while goat does not out-perform beef and pork in taste-tests, it competes well and is received favorably among many people.

The histograms in Figure 5 testify to this result. Most of the respondents indicated they do like the tenderness, flavor, juiciness, and overall satisfaction of goat meat. However, like in the sign test it appears that pork is preferred to goat and beef. Nevertheless, there is little variation between the attributes, in that roughly the same number of people liked its tenderness, flavor, and juiciness, so goat performs well on all three measures—as does pork and beef. This suggests

similarities among the meats, as one was not considered much more tough, distasteful, or dry than the others.

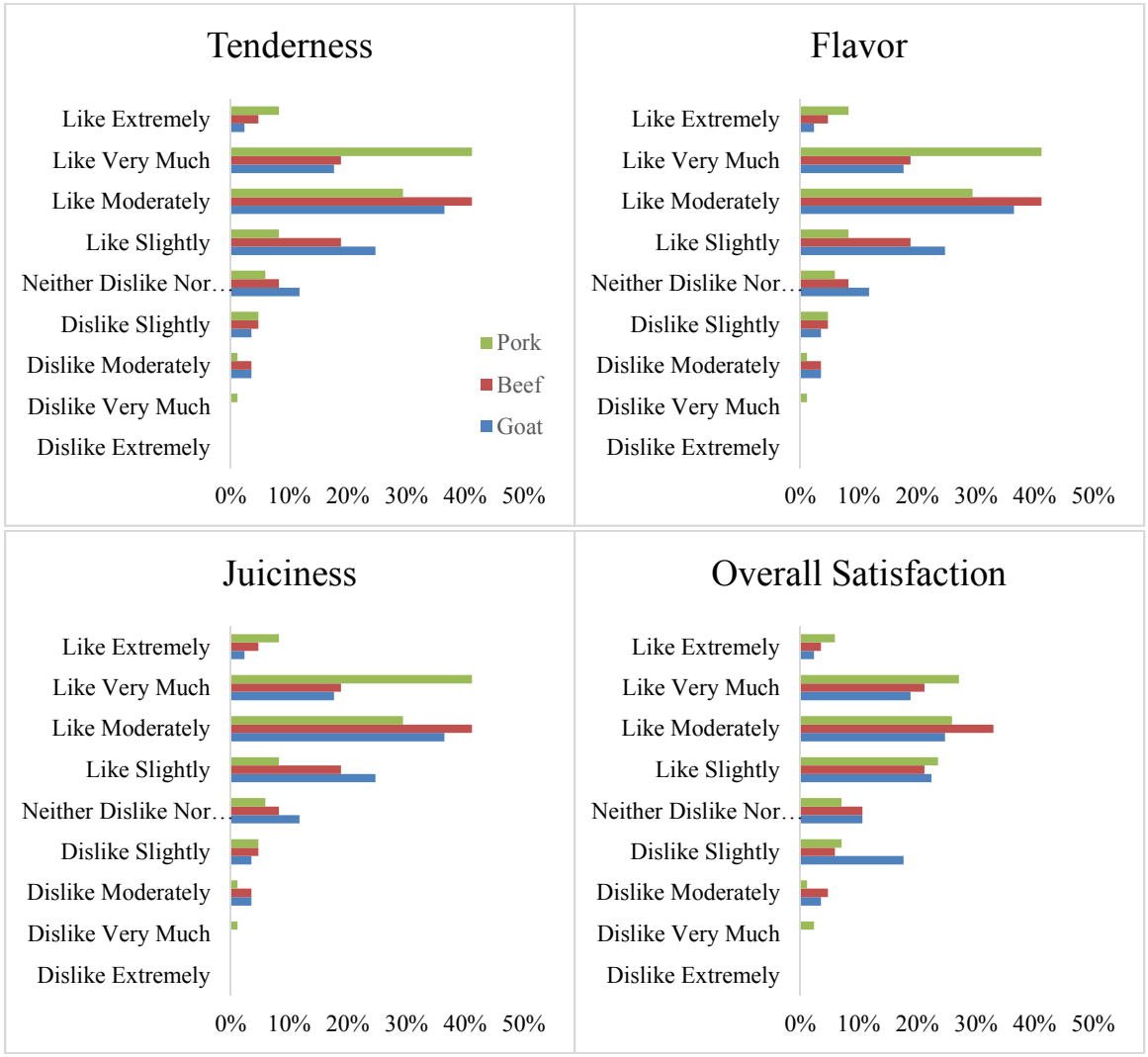


Figure 5 Histogram of participants who like or dislike each meat

III.2 Ranking

The similarities in the ratings between the three meats begs the question of whether the meats were distinct from one another. To test this we asked participants to select which two meats were the most similar, and which one meat was most distinct (Figure 6). Given that the majority of the participants reported they never eat goat (Table 2), we hypothesized that goat meat would be the most distinct out of the three meats. Figure 6 below, shows that the majority, 50%, of

participants found that pork was the most distinct followed by beef (29%) then goat (21%). This is surprising. Goat, which would be considered a novelty food to most Americans, was actually more similar to beef than pork. However novel the idea of eating goat may be, the actual eating experience is rather ordinary.

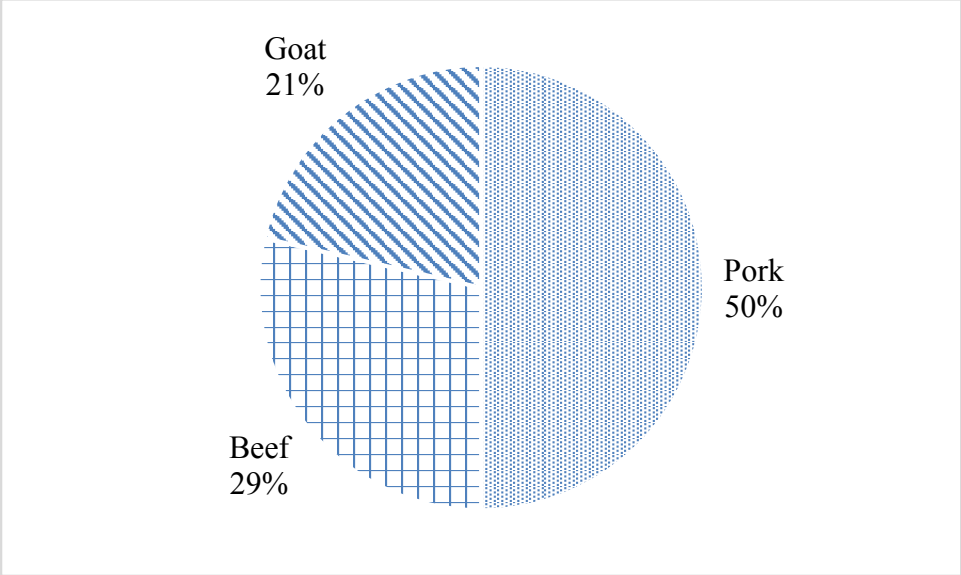


Figure 6 Pie chart of participants' choice for distinct meat

Finally, we analyzed the average rankings of each meat. Participants were asked to rank each meat giving their most favorite a "1", next favorite a "2", and least favorite a "3". In Figure 7 we see the average rankings of the adult and students surveyed. While adults prefer beef we see that students prefer pork. Although neither group prefers goat, it does have a ranking higher than 1, meaning that it is not consistently the least favorite meat.

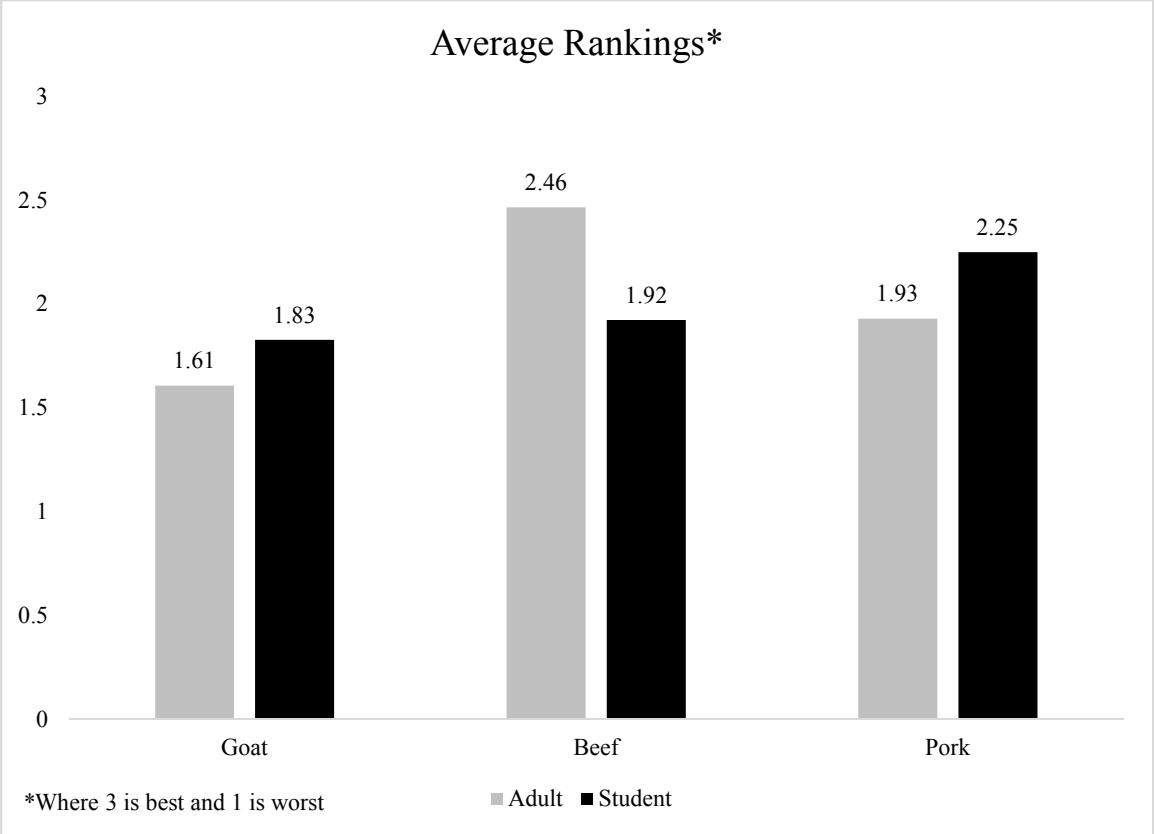


Figure 7 Histogram of favorite meat ranking

While the average rankings showed there were differences in how participants perceived the different meats, the impact of demographics is evaluated more closely using rank-ordered logit models (Table 2). We estimated four different models to determine what variables standout. According to Fok et al. (2012) the rank ordered logit is the standard tool for analyzing preferences when the data is rank ordered.

Table 2. Estimates of unrestricted and restricted rank ordered logit models and log likelihood function. P-values are in parentheses below estimated values.
(N=80 subjects)

Variable	Model 1	Model 2	Model 3	Model 4
Beef	0.429	-	1.214	0.408
	(0.04)	-	(0.00)	(0.09)
Pork	0.448	-	0.406	0.429
	(0.03)	-	(0.27)	(0.07)
Beef or Pork	-	0.438	-	
	-	(0.18)	-	
*Student*Beef*	-	-	-1.131	
	-	-	(0.02)	
*Student*Pork*	-	-	0.098	
	-	-	(0.83)	
*Beef or Pork*Eat Goat*				0.08
				(0.86)
Log Likelihood Function	-140.293	-140.297	-135.766	-140.277

Variable *Student* includes all respondents who participated in the taste test on the university campus

First, to test whether the rankings in Figure 7 are statistically different from one another, Models 1 and 2 are estimated. The first of these two models, Model 1, has two variables, *Pork* and *Beef*. While the second model contains only one variable, *Beef or Pork*, which is given a value of 1 if either meat is picked over goat. In order to compare these models, Model 1 will become the restricted model because it has one fewer variable and Model 2 will be unrestricted. Using the log likelihood function values we can estimate the chi-squared statistic, by performing a log likelihood test. Comparing the restricted and unrestricted model, the chi-squared statistic equals 2(140.393-140.297) = 0.0074. Evaluating the cumulative chi-squared distribution with one degree of freedom, the probability of a Type I Error (which is the probability of seeing a statistic greater than or equal to the chi-squared value of 0.0074 when the null hypothesis is not rejected) is 93.1%. To determine if our hypothesis is rejected we will be using the statistical p-value with a 5% threshold, a 95% confidence level. The estimates for Model 1 and Model 2 are in Table 1, after comparing the estimated values of the restricted and unrestricted models, the correlated p-

value is 0.931. Thus, the null hypothesis, Beef=Pork, is not rejected, implying that individuals are indifferent between beef and pork compared to goat.

While the previous model indicated that participants did not have a preference between beef and pork there may be subgroups that have distinct preferences for certain types of meat. For the purpose of this study, being a student was considered a potential variable of interest. To determine if any significant differences existed between how the students evaluated the meats versus the adults, additional variables were added to the model so that the preference for each group were described by different parameters. This was done by creating a dummy variable *Student* and allowing it to interact with the variables *Pork* and *Beef* (Model 3). A similar likelihood ratio test was performed to test the null hypothesis, $\alpha_3 = \alpha_4 = 0$. The restricted model, Model 1, requires estimating two fewer parameters, indicating two degrees of freedom, with a *p-value* of 0.011. With this p-value we would reject the null hypothesis at a 95% confidence level and conclude that if a participant was a student they would behave differently than if they were an adult.

To determine if people who say they eat goat rank the meat higher we created a dummy variable *EatGoat* where if they said they ever eat goat the variable gets a "1" and a zero otherwise. Then we made the variable interact with the variable *Beef or Pork*. It appears that *EatGoat* may have a small effect on the ranking of the meats however, the p-value is too large therefore the variable is not significant.

CHAPTER IV

DISCUSSION AND OUTLOOK

IV.1 Discussion

We evaluated Midwesterner's consumer preferences for shredded, slow-cooked goat meat in comparison to two commonly consumed red meats: pork and beef. Although consumers preferred the pork and beef to goat, they still viewed goat meat favorably. A meat type does not have to be the highest ranked meat to find a permanent place in Americans' meal, so long as people possess different tastes and desire variety. Whatever the reason, goat is seldom eaten in the U.S., its taste is not the obvious one.

This study was conducted on the basis that goat's seldom dinner table appearance is a curious fact and that only a few studies have compared its taste to other popular meat. Two notable exceptions are Rhee, Myers, & Waldron (2003) and Degner and Lin (1988), who also use untrained subjects in a blind taste-test, but their experiments differed in a number of ways. The Rhee study compared unseasoned ground beef and goat, both made from various cuts of the animal carcass, whereas our study focused on shredded shoulder and chest meat and provided identical seasoning to both. Using unseasoned meat it is not surprising that the Rhee study found lower overall hedonic scores (they used the same nine-point scale) than those in our study. What is surprising is that the Rhee study found that their subjects tended to prefer whatever meat they ate first. Goat was preferred to beef, so long as goat was tasted first (and vice-versa). However,

this preference effect was not present in our data, as goat's overall score for satisfaction was lowest when it was tasted first.

The Degner study better resembled our experiment design in that the beef and goat were slow-cooked and presented in a blind taste-test, but differed in that the meat was cut into 0.5 inch cubes (instead of shredded) and no seasonings were used (we used identical seasonings). They did, however, allow their subjects access to salt shakers. They used only the bottom rounds of the beef carcass and most of the whole goat carcass, so our studies differ in this respect also. Subjects in the Degner study were on average indifferent between the two meats, rating both about the same in regards to tenderness, flavor, and overall appeal. Goat was appraised as too dry, as opposed to beef's "just right" juicy rating, but still the authors conclude that, "In terms of the meats' smell, overall taste and overall appeal, the ratings suggest that participants did not have strong preferences toward either of the meats," (Degner and Lin, 1988, page 7.)

All studies considered, including the present one, when goat is compared to other familiar meats in a taste-test it performs well. This does not imply that many consumers will purchase goat meat, though. If individuals knew the identities of the meats they might penalize or reward goat based on perceptions independent of its actual taste. Preconceived notions not only affect demand for products but the actual perception of taste. This is why people claim to prefer the taste of regular meat falsely labeled as humanely raised (Anderson and Barrett, 2016), and prefer the taste of regular tomatoes falsely labeled as organic (Johansson, et. al., 1999).

A bias against goat meat might arise if it is perceived as undesirable. Some might assume it is not good simply because so few stores or restaurants serve it. A recent internet survey found that most Americans perceive the taste of goat meat to be "neither tasty nor untasty" suggesting that for the average person they are neither biased against or for. However, this rating was considerably lower than that for beef, so most people do expect beef to taste better than goat meat

(Lusk, 2016). Moreover, a telephone study by Knight *et. al.* (2006) found that 57% of respondents in southeastern states were unwilling to consume goat meat, so there does seem an aversion to the meat from a considerable number of people. These considerations might cause goat meat to be rated higher in a blind taste-test compared to a setting where they knew the identity of the meat.

On the other hand, those displaying a social desirability bias might rate the goat meat higher than it would in a blind taste-test. If a researcher is advertising free samples of goat meat then subjects might perceive the researchers are interested in promoting the product, and in appreciation for the sample may tell the researcher they like it more than they really do.

The fact that preconceived notions and social desirability bias impacts taste perceptions makes the study by Nelson *et. al.* (2004) less relevant to the present study, as they asked people to taste barbequed goat meat in a context where people knew what they were eating. Nevertheless the Nelson study does provide insights into the acceptability of goat meat, so it is worth noting that although after tasting the goat most people indicated it was as good as beef or pork barbeque. Although they only tasted goat barbeque, they were asked to first rate it compared to beef barbeque and then compare it to pork barbeque. When the subjects did not rate it "about the same" as beef or pork barbeque, they tended to rate goat better than beef barbeque but not as good as pork barbeque. This relative preference to beef and goat is probably related to the location of the experiment. Barbeque in the southeast is dominated by pork, and so by holding the experiment in Georgia it was natural that pork would be rated highest. Moreover, the authors show that whether goat was rated higher than beef depended on whether they had previously consumed goat meat. Those with experience eating goat tended to like it better than beef, while those that didn't preferred beef. It is not clear whether this difference reflects innate differences in tastes or preconceived notions. Regardless, the Nelson study concurs with our findings that even

if goat is not considered the superior tasting meat, it is certainly acceptable and provides a pleasurable eating experience to many.

How goat compares to beef and pork then depends on the study, but this is not surprising given that the meat was prepared differently across the studies. Nelson used barbequed goat whereas the Rhee study used goat loaves and chili. We decided that using a barbeque method is ideal because it does a good job of masking the identity of the meat in addition to giving all the meats a good starting point when it comes to flavor, tenderness, and juiciness. Additionally, it is a common method of cooking all three meats. Although these two studies differ in a number of ways one of the similarities is that both mention that about half of their respondents had never eaten goat meat. While Rhee, Myers, and Waldron (2003) do note that some of those who had previously eaten goat meat did not like it, Nelson et al. (2004) did not include any indication of their previous experiences. According to a telephone survey conducted by Knight et al. (2006) respondents' perception towards goat meat has a large impact on their willingness to consume it.

Knight et al. (2006) performed a telephone survey in southern states made up of six different categories, including consumption behavior and willingness to consume goat meat, in hopes of uncovering consumer preferences for goat meat. Their results suggest that demographics, socioeconomic, and geographic variables all make an impact on shoppers' willingness to consume goat meat. When looking specifically at potential consumers they found ethnicity was a large factor, and Hispanics and African Americans were more likely to be willing to consume goat meat. Additionally, they found that those with professional or graduate degrees were more likely to be potential consumers.

It is important to consider that few evaluations of consumer preference for goat meat have been conducted and much of the previous work are at least a decade old and many times were not blind sensory analysis. Additionally, all of these evaluations mention that more studies

need to be conducted to have a better outlook at the future of goat meat in America. Each of the taste tests done in the past have attributes that were utilized in our taste test. Similar to Rhee, Myers, and Waldron (2003), we utilized the 9- point hedonic scale and randomized the meats so their identity was not revealed. We decided that barbequing the meat would be the most effective way of cooking the three meats comparable to Nelson et al (2004). However, each of these studies had limitations. Rhee, Myers, and Waldron (2003) were limited to students and staff at a Texas University and only provided a comparison between beef and goat. While, Nelson et al. (2004) gave away sample of goat meat but did not give away samples of any other meat and the questionnaire was not completed on site, which could lead to respondents forgetting or romanticizing the experience. And Knight et al. (2005) did not provide any sort of taste test considering it was a telephone survey.

IV.2 Outlook

Americans are getting more interested in new and different foods including goat meat. This has created an expansion of the US goat meat industry, which has increased from about 750,000 head in 2000 to over 1 million goats in 2013 (FAO pocketbook, 2015). Producers of other livestock industries may be able to take advantage of the changing US palette, by utilizing goats to diversify their operation. Goats can be used to control brush in addition to improving grazing for cattle by eating weeds that cattle do not like. Their small size and gregarious disposition might make them the ideal livestock species for combining food production with agritourism. In addition to utilizing goats for cleaning up land goats have become somewhat trendy on their own from videos online of fainting goats to goat yoga. In fact according to the USDA, 'fun/hobby' was rated as one of the top reasons for raising meat goats, even surpassing income (APHIS, 2012).

While goat yoga may seem a bit farfetched for some producers another way to diversify is raising meat goats for livestock shows, primarily for school aged children participating in 4H

and FFA. Although livestock shows were created in the early 1900s goats have only been part of the show for about 20 years now. In fact the Oklahoma Youth Expo started its goat show in 2004 with an estimated 250 market goats being shown, this year there are expected to be over 700 market goats entered into the show. Even if producers choose to forgo the fun aspects of raising goats, there are still many positives to the industry including brush control and supplemental income. Just as goat milk sales are rising and finding a greater presence in American grocery stores (Nania, 2016), this study suggests goat meat has the potential to follow likewise.

CHAPTER V

CONCLUSION

Although it appears pork and beef producers do not need to fret about the potential of goat meat taking a large portion of their consumers, it is evident that people find goat meat to be palatable. The present study, which compared pork and beef directly to goat, found goat to be the least favored meat of the three but nevertheless receiving favorable ratings. When compared to goat, pork and beef are interchangeable and having eaten goat meat in the past made little to no effect on how participants rated goat meat on the survey. Additionally, there was evidence that the students surveyed behaved differently than their adult counterparts.

Due to the constrained focus of this study certain limitations existed. While we are located in a college town with a variety of people our study was skewed with a majority of the participants being Caucasians. Considering previous studies suggested that Hispanics and African Americans were more likely to be consumers of goat meat, this may have had an effect on our results. Another drawback to our study is the blind taste test, since the participants were not aware of what they were eating their true preferences were not evident. While this is desirable for evaluating the experience attributes of meats, it cannot be used to predict actual store purchases. Finally, we chose to barbeque all three meats which may have masked the flavor of the three meats giving them all a similar taste resulting in most of the hedonic scores falling in a small, close range. Having established that goat meat is enjoyable to most of the participants leads us to

believe that there is a need for future research in this area to discover why goat meat is seldom eaten in the United States.

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APPENDICES

APPENDIX A

IRB Approval Letter

Oklahoma State University Institutional Review Board

Date:	Monday, August 24, 2015
IRB Application No	AG1539
Proposal Title:	Preferences for Meat
Reviewed and Processed as:	Exempt

Status Recommended by Reviewer(s): Approved **Protocol Expires: 8/23/2018**

Principal Investigator(s):

F. Bailey Norwood
426 Ag Hall
Stillwater, OK 74078

Hammons Hepner
Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

☒ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1.Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval. Protocol modifications requiring approval may include changes to the title, PI advisor, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms
2.Submit a request for continuation if the study extends beyond the approval period. This continuation must receive IRB review and approval before the research can continue.
3.Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of the research; and
4.Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Dawnett Watkins 219 Scott Hall (phone: 405-744-5700, dawnett.watkins@okstate.edu).

Sincerely,

Hugh Crethar, Chair
Institutional Review Board

PARTICIPANT INFORMATION
OKLAHOMA STATE UNIVERSITY

Project Title: *Preferences for meats*

Investigator(s):
Bailey Norwood, Department of Agricultural Economics.
Hammons Hepner, Department of Agricultural Economics.

Purpose: To better understand people's preferences for meats.

What to Expect: To participate in this study you must be willing to taste three different meat products and provide feedback on your eating experience, along with some demographic questions. You will record your answers on a questionnaire. A free lunch is then held and we will ask you about your perceptions of the meat products we serve. These remarks will be recorded but not linked to any name or contact information.

Risks: There are no risks associated with this project which are expected to be greater than those ordinarily encountered in daily life. All meats are prepared by food scientists at Oklahoma State University following all health and safety regulations. At no point do we ask your contact information, so your identity cannot be matched with your responses.

Benefits: A chance to help researchers understand your preferences for ground beef. There is a free meal after the questionnaires have been submitted, but you may participate in the free lunch regardless of whether you participate in the taste-test.

Your Rights and Confidentiality: Your participation in this research is voluntary. There is no penalty for refusal to participate, and you are free to withdraw your consent and participation in this project at any time. If you feel you may have an allergy to any of the foods, please let the researchers know promptly, and you may cease participating with no penalty.

Confidentiality: Your questionnaire is given an identification number and never asks for your contact information. Any recorded remarks made at the free lunch will not contain any name or contact information. Thus, it would be impossible for anyone to match your responses to your identity.

Contact: You may contact any of the researchers at the following addresses and phone numbers, should you desire to discuss your participation in the study and/or request information about the results of the study:

Bailey Norwood. 426 Ag Hall. Department of Agricultural Economics. Oklahoma State University. 405-334-0010. bailey.norwood@okstate.edu. fbaileynorwood.com.

If you have questions about your rights as a research volunteer, you may contact the IRB Office at 219 Cordell North, Stillwater, OK 74078, 405-744-3377 or irb@okstate.edu

CONSENT DOCUMENTATION:
I have been fully informed about the procedures listed here. I am aware of what I will be asked to do and of the benefits of my participation. I also understand the following statements:
I affirm that I am 18 years of age or older.

Preface the signature lines with the following statement (expand if appropriate):
I have read and fully understand this consent form. I sign it freely and voluntarily. A copy of this form will be given to me. I hereby give permission for my participation in this study.

Signature of Participant _____ Date _____

I certify that I have personally explained this document before requesting that the participant sign it.

Signature of Researcher _____ Date _____

Okla. State Univ.
IRB
Approved 8-23-15
Expires 8-23-16
IRB # AG-15-39

DEPARTMENT OF
Agricultural
Economics

F. Bailey Norwood

426 Agricultural Hall · Stillwater, OK 74078 · 405 744 9820 · Cell: 405 334 0010 · fbaileynorwood.com · bailey.norwood@okstate.edu

October 26, 2015

Dear SST Software employees:
You are invited to a meat taste-test project that will be conducted at your office on Thursday, October 29, 2015. It is conducted by Bailey Norwood (professor) and Hammons Hepner (undergraduate student) from the Department of Agricultural Economics at OSU, and is part of a senior-level class project.

What does the project involve? Between 11 AM and noon on October 29, OSU students will bring trays to your desk. Each tray will contain three meat samples, and the taste-test simply asks (your participation is voluntary) you to taste each meat and complete a short questionnaire about your eating experience. The questionnaire also contains some demographic questions but never will you be asked for your name or contact information. Then, at noon, you will be provided with a free lunch containing these meats and various side dishes.

Why is the research being conducted? Part of my research concerns consumer preferences for food, and your participation helps us better understand consumer attitudes towards different meats. The data will also be used as class project for *AGEC 4213—Advanced Quantitative Methods in Agricultural Economics*.

Who may participate? Any SST employee at the office on October 29 who wishes to. It is purely voluntary. You may attend the free lunch even if you do not perform a taste test.

Do I need to sign up? No. We are bringing the project to your office, and so you can either accept or decline on this day. There will be ample amounts of food to accommodate everyone.

Are there any risks involved with participating? No more risk than that associated with your usual meals. The meats are not exotic and will be prepared by food scientists at the Food and Agricultural Products Center (FAPC) at OSU.

If you have any questions, please do not hesitate to contact me (see contact info above). We look forward to seeing you on Thursday!

Sincerely,

F B Norwood

F. Bailey Norwood
Professor

Pending

Okla. State Univ.
IRB
Approved 8-24-15
Expires 8-23-18
IRB # AG-15-39

Oklahoma State University Institutional Review Board

Date:	Thursday, February 18, 2016	Protocol Expires:	8/23/2018
IRB Application No:	AG1539		
Proposal Title:	Preferences for Meat		
Reviewed and Processed as:	Exempt **Modification**		

Status Recommended by Reviewer(s) **Approved**

Principal Investigator(s):

F. Bailey Norwood
426 Ag Hall
Stillwater, OK 74078

Kelyn A Jacques
5010 Stonecrest Ct
Stillwater, OK 74075

The requested modification to this IRB protocol has been approved. Please note that the original expiration date of the protocol has not changed. The IRB office MUST be notified in writing when a project is complete. All approved projects are subject to monitoring by the IRB.

☐ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

The reviewer(s) had these comments:

Modification to 1)change Co-PI from Hammons Hepner to Kelyn Jacques, 2) increase number of subjects to 100 and 3) include members and guests of Alpha Gamma Rho fraternity in study.

Signature :

Hugh Crethar, Chair, Institutional Review Board

Thursday, February 18, 2016
Date

APPENDIX B

Experiment Questionnaire

Blue **A**

THANK YOU FOR PARTICIPATING IN THIS TASTE-TEST!

- In front of you are three different containers, labeled SQUARE, CIRCLE, OR TRIANGLE.
- In a moment you will taste each of the meats and report your eating experience.
- On the tray are toothpicks you may use to handle the meat.
- Before tasting each meat, make sure you cleanse your palette by eating one cracker and taking a sip of water.
- Make sure you answer all the questions.
- Please do not discuss this with others until everyone has taken a taste-test.
- A student will come pick up your tray and questionnaire.

10

Blue **A**

First, eat one cracker and take a sip of water.

(1) Please taste the meat in the container labeled **Square** and answer the following questions.

Please indicate the extent to which you like or dislike the tenderness, flavor, juiciness, and overall satisfaction of the meat labeled **Square**.

		Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely
Square	Tenderness	○	○	○	○	○	○	○	○	○
	Flavor	○	○	○	○	○	○	○	○	○
	Juiciness	○	○	○	○	○	○	○	○	○
	Satisfaction with overall eating quality	○	○	○	○	○	○	○	○	○

Blue **A**

Then, eat one cracker and take a sip of water.

(2) Please taste the meat in the container labeled **Circle** and answer the following questions.

Please indicate the extent to which you like or dislike the tenderness, flavor, juiciness, and overall satisfaction of the meat labeled **Circle**.										
Circle	Tenderness	Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely
	Flavor	Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely
	Juiciness	Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely
	Satisfaction with overall eating quality	Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely

Blue **A**

Then, eat one cracker and take a sip of water.

(3) Please taste the meat in the container labeled **Triangle** and answer the following questions.

Please indicate the extent to which you like or dislike the tenderness, flavor, juiciness, and overall satisfaction of the meat labeled **Triangle**.

		Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely
Triangle	Tenderness	○	○	○	○	○	○	○	○	○
	Flavor	○	○	○	○	○	○	○	○	○
	Juiciness	○	○	○	○	○	○	○	○	○
	Satisfaction with overall eating quality	○	○	○	○	○	○	○	○	○

(4) Please rank each meat according to your overall satisfaction. Assign a ranking = 1 to your favorite meat, a ranking = 2 to your next favorite meat, and a ranking = 3 to your least favorite meat. Even if two meats seem like a tie, pick one to rank higher.

☐ Square

☐ Circle

☐ Triangle

(5) Now we want you to guess the rankings of the average American, if they were taking this taste-test today. Assign a ranking = 1 to the meat you believe the average American would like the best, a ranking = 2 to the average American's next favorite meat, and a ranking = 3 to the average American's least favorite meat.

☐ Square

☐ Circle

☐ Triangle

(6) Which two meats were the most similar, and which one meat was the most distinct? Please place a check beside the <u>two</u> meats that seem the most similar, and an "x" mark by the <u>one</u> meat that seemed the most distinct.

☐ Square

☐ Circle

☐ Triangle

A few more questions

(7) What is your gender?

☐ male ☐ female

(8) What is your age? _____ years

(9) How often do you eat the following meats? *Please check ONE option for each row.*

Chicken	☐ Never	☐ Rarely	☐ Occasionally	☐ Frequently
Rabbit	☐ Never	☐ Rarely	☐ Occasionally	☐ Frequently
Turkey	☐ Never	☐ Rarely	☐ Occasionally	☐ Frequently
Pork	☐ Never	☐ Rarely	☐ Occasionally	☐ Frequently
Beef	☐ Never	☐ Rarely	☐ Occasionally	☐ Frequently
Lamb	☐ Never	☐ Rarely	☐ Occasionally	☐ Frequently
Goat	☐ Never	☐ Rarely	☐ Occasionally	☐ Frequently
Wild Game	☐ Never	☐ Rarely	☐ Occasionally	☐ Frequently
Seafood	☐ Never	☐ Rarely	☐ Occasionally	☐ Frequently

(10) What is your pre-tax, annual household income level? *Please check ONE option.*

☐ less than $10,000
☐ $10,00 to $19,999
☐ $20,00 to $29,999
☐ $30,00 to $39,999
☐ $40,00 to $49,999
☐ $50,00 to $59,999
☐ $60,00 to $69,999
☐ $70,00 to $79,999
☐ $80,00 to $89,999
☐ $90,00 to $99,999
☐ $100,00 or more

(11) How many people reside in your household, including yourself?

_____ people

(12) Which of the following best describes your role in purchasing food for your household? *Check one option only.*

☐ I am the only person in my household

☐ I am the primary shopper for my household

☐ Though not the primary shopper, I play a significant role in determining the food our household eats

☐ I play little to no role in determining the food my household eats

(13) Are you a vegetarian or vegan? ☐ yes ☐ no

(14) What is your weight? _____ lbs

(15) What is your height? _____ feet and _____ inches

(16) What is your highest level of education?

☐ No high school diploma

☐ High school diploma

☐ Associate's degree

☐ Bachelor's degree

☐ Graduate degree

(17) Which of the following best describes your race or ethnicity? *Please check all that apply to you.*

☐ American Indian or Alaska Native

☐ Asian

☐ Black or African American

☐ Hispanic

☐ Native Hawaiian

☐ Other Pacific Islander

☐ White

☐ Other

(18) Please indicate whether you agree or disagree with each of the following statements. *You should select one response for each row.*

Meat is environmentally friendly	☐ Agree	☐ Disagree
Meat tastes bad	☐ Agree	☐ Disagree
It is hard to get food poisoning from meat	☐ Agree	☐ Disagree
Livestock raised for meat experience suffering	☐ Agree	☐ Disagree
Meat is a healthy food	☐ Agree	☐ Disagree
The price of meat is high	☐ Agree	☐ Disagree

(19) Please select the option that best describes your relationship to SST

☐ I work full-time for SST

☐ I work part-time or as an intern for SST and am currently pursuing a college degree

☐ I work part time or as an intern for SST and am NOT currently pursuing a college degree

☐ I am taking classes from SST

☐ Other

APPENDIX C

STATA Code

```
use H:\STATA\Goat\GoatData.dta
append using H:\STATA\Goat\GoatData.dta, generate(newapp2)
append using H:\STATA\Goat\GoatData.dta, generate(newapp3)
generate goat=0
replace goat=1 if(newapp2==0 & newapp3==0)
generate beef=0
replace beef=1 if newapp2==1
generate pork=0
replace pork=1 if newapp3==1
generate Rank=grank if (newapp2==0 & newapp3==0)
replace Rank=brank if newapp2==1
replace Rank=prank if newapp3==1
sort surveyid
bysort surveyid: egen getridof=min(Rank)
drop if getridof==-999
summarize
rologit Rank beef pork, group(surveyid) reverse
generate beefandpork=beef+pork
generate beefandgoat=beef+goat
generate porkandgoat=pork+goat
rologit Rank beefandpork, group(surveyid) reverse
generate agr=atsst==4
generate agrbeef= agr*beef
generate agrpork= agr*pork
rologit Rank beef pork agrbeef agrpork, group(surveyid) reverse
rologit Rank beef pork, group(surveyid) reverse
```

VITA

KELYN ANNA JACQUES

Candidate for the Degree of

Master of Science

Thesis: MIDWESTERENERS' CONSUMER PREFERENCE FOR GOAT MEAT IN A BLIND SENSORY ANALYSIS

Major Field: Agricultural Economics

Biographical:

Education:

Completed the requirements for the Master of Science in Agricultural Economics at Oklahoma State University, Stillwater, Oklahoma in May, 2017.

Completed the requirements for the Bachelor of Science in Agricultural Economics at Oklahoma State University, Stillwater, Oklahoma in 2014.

Experience:

- Graduate Research Assistant, Department of Agricultural Economics
  Oklahoma State University, Stillwater, Oklahoma 2015-2017
- Graduate Teaching Assistant, Department of Agricultural Economics
  Oklahoma State University, Stillwater, Oklahoma Fall 2015
- Teaching Assistant, Department of Agricultural Economics
  Oklahoma State University, Stillwater, Oklahoma 2013-2015
- Student Employee, County Training Program
  Oklahoma State University, Stillwater, Oklahoma 2012- 2015
- Lake Survey Administer, Department of Agricultural Economics
  Oklahoma State University, Stillwater, Oklahoma Summer 2014
- Junior Intern, Karen Carmichael and Associates, P.C.
  Tulsa, Oklahoma Summer 2013

Professional Memberships: