

AN ABSTRACT OF THE THESIS OF

Emily M. Jorgensen for the degree of Master of Science in Food Science and Technology presented on August 12, 2004.

Title: Effects of Closure Type on Consumers' Perception of Wine Quality.

Abstract Approved:

Anna B. Marin

Natural corks have long been used as wine closures. However, they are associated with causing multiple adverse effects to the wine they are attempting to preserve. Alternative closures such as synthetic corks and screw caps were developed in order to reduce and/or eliminate these problems. However, the major cause of concern regarding these closures is of consumers' acceptance. The effect of how three types of closures (Natural Cork, Synthetic Cork and Screw Cap) affected wine consumers' perceptions of the quality of wine was examined in this study. This project was divided into two experiments. The first experiment determined if frequent wine consumers could detect sensorial differences between the three closure types. The second experiment ascertained if and how regular wine consumers' perceptions were altered based on the type of closure with which the wine samples were bottled. It was determined that the wine consumers could not significantly detect a difference between any

of the three closure type samples based only on sensory stimuli. The results from the second experiment found for the Chardonnay samples, the knowledge that the wine samples came from a natural cork or a synthetic cork did not significantly affect the liking, quality or purchase intent scores. However, when the panelists knew that the sample was bottled with a screw cap, they thought it was of lower quality, were less willing to buy a wine like the sample and they lowered the price they were willing to pay. For the Merlot samples, knowledge that the sample came from a natural cork caused the wine consumers to significantly increase both their opinions of the quality of the wine and the amount they were willing to pay for the wine. When they knew that the sample was bottled with a screw cap, they reduced the price they would pay for the wine.

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Effects of Closure Type on Consumers' Perception of Wine Quality

by
Emily M. Jorgensen

A THESIS

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APPROVED:

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I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.


Emily M. Jorgensen, Author

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Dedication

In loving memory of my grandmother, Janet Louise Gunderson.

Effects of Closure Type on Consumers' Perception of Wine Quality

1. Introduction

Natural cork closures have been used in the wine industry since ancient times. However, they have not been without problems. Cork taint, random oxidation, leakage and deposits are the main sources of aggravation. Alternative closures such as synthetic corks and screw caps were developed in order to overcome these problems. However, the main concern within the wine industry, primarily with screw caps, is consumers' perception of wine quality when it is packaged with these closures. The purpose of this study was to address this concern.

The study was split into two experiments. The first experiment addressed the issue of whether wine consumers could detect a sensorial difference, primarily taste or aroma, between the wines stored in each of the three closure types (Natural Cork, Synthetic Cork, and Screw Cap). The second experiment explored how knowledge of the type of wine closure affected wine consumers' perception of the quality of the wine sample.

2. Literature Review

2.1 *Natural Cork*

The use of cork as stoppers can be traced back to the ancient Greeks and Romans for use in their wine amphoras (Tchernia, 1986 and Oliveira, 1994). The oldest known use of cork as a wine seal was found in Tuscany in the sixth century B.C. in an Etruscan amphora (Joncheray, 1976). With the collapse of the Roman Empire, there was a decline in the use of amphoras; thus, there was a resulting drop in the use of cork (Jackson, 1994). Corks came back into generalized use when Dom Pierre Pérignon (1639-1715), to whom the process of champagne production is attributed, observed that the current champagne closures, wooden stoppers wrapped in hemp soaked in olive oil, would often pop out of the champagne bottles due to the high pressure generated by the carbon dioxide in the bottle. He found that conical cork plugs were a more effective closure, as they could withstand the pressure and remain in the bottle (Oliveira, 1994). Also contributing to the major reemergence of the cork as a wine closure was the beginning of the industrial-scale glass bottle manufacture in England in the mid-seventeenth century (Jackson, 1994). Since this time corks have remained the most established type of wine closure.

Cork has remained the wine closure of choice since ancient times due to its numerous positive physicochemical properties. Four examples of these properties described by Jackson (1994) include compressibility

and resilience, chemical inertness, imperviousness to liquids, and a high coefficient of friction.

Corks show impressive resilience on the release of pressure. They return to 85% of their original dimensions almost immediately, and they regain approximately 98% of the original volume within the next few hours. This is due to the distinctive wall structure and the sealed nature of the cells. This ability to almost immediately return to its original shape also gives the cork much of its sealing properties. Its elasticity puts pressure on the neck of the wine bottle, thus producing a tight seal for years (Jackson, 1994).

Cork's chemical inertness is a second positive characteristic which makes it a highly suitable wine closure. As wine is frequently stored for multiple years, it is imperative that its closure does not impart unfavorable sensory properties. The boiling of cork after its harvest extracts most of the compounds that would negatively affect the wine during storage. There are also few breakdown products that form from the cork and diffuse into the wine (Jackson, 1994).

The combination of the tightly packed cork tissue provides few channels through which fluids can pass (Jackson, 1994) and the presence of suberin (a complex mixture of fatty acids and heavy organic alcohols) make corks impermeable to liquids (Oliveira, 1994). Gases, water vapor and fat-soluble compounds can still diffuse into cork. However, once the corks are inserted into the glass wine bottles, appreciable movement of

these substances is limited. This could be due to the pressure produced within the cork cells from the compression in the neck of the bottle (Casey, 1993). Singleton (1976) estimated that oxygen penetrates cork-sealed bottles of wine at a rate of approximately 0.1 ml/liter per year. Also, during the first few years of storage up to about 0.5 ml of oxygen may be absorbed by the wine. This is associated with wine seepage caused by temperature fluctuations (Ribereau-Gayon *et al.*, 1997). The slight amount of penetration and absorption of oxygen generally does not adversely affect the sensory properties of the wine. In fact, it has long been considered that limited oxygen exposure throughout the winemaking process leads to improved wine quality (Ribereau-Gayon *et al.*, 1983)

The high coefficient of friction that cork possesses has perpetuated its role as the accepted wine closure choice. When a cork is cut, its surfaces form microscopic suction cups that hold tightly to the glass bottles (Jackson, 1994). Also, during compression there is an inelastic loss of energy which increases the friction between the glass and the cork (Gibson *et al.*, 1981). These properties, along with its resilience, result in the long-term, tight seal between the cork and the glass after 8 to 24 hours (Jackson, 1994).

Unfortunately natural corks can also cause problems in the wine bottles they intend to preserve. Some of these problems include cork taints, bottle leakage, random oxidation and deposits.

Those familiar with wine and the wine industry have most likely experienced the well-known problem of cork taint. Cork taint imparts a moldy or wet cardboard character to the wine (Stelzer, 2003). It is most commonly attributed to 2,4,6-trichloroanisole (TCA), which can be detected even at a few parts per trillion in wine (between 1.5 – 3 ng/L) (Duerr, 1985). Recently, Chatonnet et al (2004) have identified another possible cause of the musty “corked” odor often attributed to TCA. They identified 2,4,6-tribromoanisole (TBA) in wines that had a significant musty character and in which there were insufficient quantities of chloroanisoles (such as TCA) to produce this defect. They determined that TBA is apparently produced by the microbiological breakdown of 2,4,6-tribromophenol (TBP) and TBA can be detected in wines at a limit of 0.90 ± 3.50 ng/L.

Although natural corks normally create tight seals, leakage can still be a problem. Leakage is generally defined as the expulsion of a few drops of liquid, as it is rare that bottles leak continuously when inverted (Stelzer, 2003). It can result from a number of causes primarily due to individual differences in the corks and glass wine bottles as described by Jackson (1994). There can be gaps between the cork and the neck of the bottle due to incorrect bore size or imperfections in the glass surface which result in leakage. Also, improper alignment or compression of the cork during insertion can create structural faults in an initially flawless cork. Laying bottles on their sides immediately after they are filled and corked or rapid temperature fluctuations during storage or shipment can also induce

leakage. Structural imperfections in the cork typically cause leakage, however improper sizing during manufacturing can also be a cause.

Natural corks have also been named as a cause of random oxidation of wine. Many blame physical defects in the corks, often associated with the lower grades of corks that allow excess amounts of oxygen to enter the wine bottle, thus oxidizing the wine (Stelzer, 2003).

Finally, corks can occasionally be a source of wine deposits. Jackson (1994) identifies three causes of the wine deposits from corks. The most common cause is from lenticular dust from the corks which can be loosened during transport. Also, the paraffin or silicone that is used to coat the corks in order to limit dust release can be defective or non-uniform and thus release particulate material. A third cause is improper corking which results in physical damage to the cork and can therefore result in the release of cork particles into the wine.

2.2 Synthetic Cork

As a result of the many faults due to natural corks, winemakers have looked to alternative closures in order to solve these problems and better preserve their wines and their wineries' reputations. Synthetic or plastic corks are one of the more popular and well-known types of alternative closures. They were first introduced in the 1970's (Fugelsang, 2003). According to Casey (2002), the first stoppers were unsuccessful mainly due to sporadic problems with insertion, sealing, extraction, taints and

oxidation. However, the manufacturers of the stoppers further developed the technology to reduce and/or eliminate these problems. Today plastic stoppers seal about 9% of the 17 billion bottles of wine produced each year (Bonne, 2003).

The first synthetic stoppers successfully used were made of polyethylene (Jackson, 1994). The ethylene vinyl acetate stopper is a popular choice as it possesses most of the basic appearance and features of the natural cork (Anonymous, 1992). This stopper is created by injecting liquid ethylene acetate with air and a hardener. This forms millions of microscopic gas pockets before hardening. Similar to the natural cork, it has a resilience that allows it to return almost immediately to its original diameter (97%) after compression. Within 1 hour of compression, it regains more than 99% of its original volume (Anonymous, 1993).

The primary concern that winemakers have with synthetic corks is their ability to preserve wines for prolonged periods of time. This is due to their slow oxygen permeability (Jackson, 1994). This is not a problem for wines that are meant to be drunk relatively soon after bottling. However, for those that require aging and thus a limited amount of oxygen exposure, plastic corks are not the closure of choice.

2.3 Screw Caps

The first screw cap was patented in the United Kingdom on August 10, 1889 (Fugelsang, 2003). However, the technology for the threads on

the glass bottle had not yet been developed and therefore this closure type waited more than sixty years before a design was created exclusively for bottled wine.

In the late 1950's the Stelvin closure, with its threaded design and oxygen resistant cap liners, was introduced (Fugelsang, 2003). However, these were generally restricted to lower priced wines, and thus the low wine quality stigma began. These closures were widely used during the 1960's and 70's. They consisted of a poly laminate of four layers. The first was a thin layer of inert polyvinyl denachloride (PVDC) which was the only part in contact with the wine. The following layer formed the impermeable gas barrier and consisted of a tin film nineteen microns thick. This layer was stuck to a layer of paper and a layer of cork, which maintained the pressure of the seal. Problems arose when the application was not precisely correct and the wine moved past the PVDC and tin layers. It then came in contact with the paper, which acted as a wick, and resulted in the erosion of the cap. There were other concerns with the paper and cork not retaining resilience and maintaining their pressure (Stelzer, 2003). These problems and the lack of consumer acceptance caused screw caps to be abandoned by the early 80's.

In the late 90's there was a strong push for screw caps by winemakers in Australia and New Zealand. The technology of these closures was improved so that the layer of cork and paper were replaced by a wad of expanded polyethylene, approximately two millimeters thick.

This gave the screw cap the elastic resilience to maintain the compression of the liner onto the bottle rim (Stelzer, 2003). This improvement in the screw cap's technology essentially made the closure "wine-proof". Another benefit of screw caps, according to a study by Bach (1982), is that they retain sulfur dioxide and minimize oxidation better than cork closures, particularly when the wine bottles are stored upright. Of course, the screw caps are also preferred over cork closures as they eliminate the problem of cork taint. The main concern with screw caps is consumers' acceptance. Winemakers are concerned that consumers will look at a bottle with a screw cap and immediately associate it with a lower quality wine. The purpose of this study was to address this concern.

3. Materials and Methods

3.1 *Statement of Purpose*

The purpose of this study was to determine how the type of wine bottle closure (Natural Cork, Synthetic Cork or Screw Caps) affected wine consumers' perception of the quality of the wine sample. Also of interest was if wine consumers could detect a difference between wines that were bottled with three types of closures: Natural Cork, Synthetic Cork and Screw Caps.

3.2 *Design*

The entire study was conducted at Oregon State University's Food Innovation Center located in Portland, Oregon. Each of the experiments was conducted with participants tasting samples in one of the 10 partitioned taste booths equipped with computers and touch screen monitors. Participant data was collected using Compusense five version 4.2 throughout the study.

The study was split into two experiments. The first was a series of three triangle tests conducted to determine if consumers could detect a difference between wine samples bottled in three types of closures. The first experiment was conducted with three separate sets of subjects. The first set of consumers compared wines bottled with screw caps and those bottled with synthetic corks. The second set of consumers compared

wines with synthetic corks and those with natural corks. The third set of consumers determined if there was a difference between wine samples bottled with natural corks and those with screw caps. This experiment was conducted first and the results of this test determined the number of samples the participants would taste in the first session of the second experiment.

The second experiment consisted of two sessions with the same consumers participating in both sessions. The objective was to assess the wine consumers' perception of the wine quality and their liking ratings as they were affected by the wine closures. In this experiment, the participants were asked the same questions in both sessions regarding their opinions of the overall wine Quality, Liking ratings, Purchase Intent and Purchase Price for each of the wine samples. In the first session they were not given any information regarding the type of closure in which the wine sample was bottled and so based all of their opinions only on the sensory properties of the wine. One week later, in the second session they were given photographs of the type of closure in which the wine was bottled, so they had knowledge about the wine closure when rating its quality. Consumers' opinions of the wine quality in the second session, then, were based on the wine and the bottle closure.

3.3 Subjects

Subjects for both experiments were selected for participation based on their responses to a screener (Appendix 1.) The screener asked potential participants a variety of questions regarding how frequently they drank multiple types of beverages (Appendix 1). The criterion for inclusion in either experiment 1 or 2 was consumers' frequency of drinking both red and white wines. The questions regarding the frequency of drinking other beverages were asked in order to distract the potential participants from realizing the intent of the test and therefore falsifying their answers in order to qualify for the test. In order to qualify for first experiment, the triangle tests, the participants were required to indicate that they drank either red or white wine at least once a month. In order to qualify for the second experiment, the participants were required to indicate that they drank either red or white wine at least 2-3 times per month and the other (white or red) at least once a month. An effort was made to ensure that the majority (approximately 80%) of the participants were between the ages of 24-55.

The requirements regarding the frequency of consuming wine in order to participate in the study were reduced mid-way through the recruitment process. Initially the requirement for both tests was that the participants drank both red and white wine at least two to three times a month. However, due to the difficulty of finding participants who met both criteria, the qualification requirements were lowered to the specifications previously mentioned.

For the first experiment, participants between the ages of 21 and 65 were selected based on their interest, availability and frequency of red and white wine consumption. All were Portland Oregon area residents. Seventy-three (32 male, 41 female) subjects participated in test 1, sixty-seven (29 male, 38 female) subjects participated in test 2 and sixty-four (23 male, 41 female) subjects participated in test 3.

For the second experiment, one hundred and six (40 male, 66 female) subjects between the age of 21 and 65 were selected on the basis of their interest, availability and frequency of white and red wine consumption. All were Portland, Oregon area residents. It should be noted that one hundred and nine subjects participated in the first session, however, three of those subjects did not return for the second session. Therefore, their data was eliminated from the data analysis and this discussion. Forty-three consumers that participated in any one of the difference tests (experiment 1) also participated in the quality assessment test (experiment 2).

3.4 Samples

All the wines used in this study were provided by Hogue Cellars, Prosser, Washington. For both of the experiments, the 2000 Chardonnay, Fruit Forward and the 1999 Merlot, Vineyard Selection were used. Each of the varieties was bottled with three types of bottle closures: a Natural Cork, a Synthetic Cork (Supreme Cork) and a Screw Cap (Saranex Liner – white

foam). The Chardonnay wines were moved from their cellar storage ($50 \pm 5^\circ\text{F}$) to a refrigerator one day before the test and kept between $36\text{--}40^\circ\text{F}$. The Merlot wines were moved from their cellar storage to room temperature ($70 \pm 5^\circ\text{F}$) at the sensory facility. For both experiments, the Chardonnay samples were poured 15 minutes before they were served, so when presented they were approximately $50\text{--}55^\circ\text{F}$. The Merlot samples were poured 30 minutes before they were served. When presented, they were at room temperature ($70 \pm 5^\circ\text{F}$). One ounce pourers were used throughout the study. The one fluid ounce wine samples were presented with randomized three-digit codes in wine glasses with plastic lids covering the rims of the glasses. After the samples were poured into the wine glasses, they were covered with the plastic lids. Given the possibility that the participants might be able to see into the preparation area, all the wine bottles were placed in men's black socks labeled only with the random three-digit coding, in order to keep the identity of the wines anonymous. The samples were presented to the participants on a black plastic tray with a white paper tray liner (Appendix 4) in order to reaffirm the tasting order of the samples and verify the identities of the pectin rinse and the water.

A 1g/L pectin rinse (Ball Fruit Jell Pectin) was prepared as previously described (Colonna, 2002). The pectin rinse was used in combination with crackers and water between samples in order to help cleanse the participants' palates.

3.5 Sensory Protocol

3.5.1 Experiment 1 – Difference Tests

As previously mentioned, the first experiment was split into three tests, conducted on three consecutive days. Although the comparison of closures varied each day, the method was replicated as precisely as possible and therefore will only be described once.

Upon arrival to the Food Innovation Center, where all of the tests were conducted, the participants were asked to read and then sign the informed consent forms to insure they understood the nature of the test and that participation was voluntary (Appendix 2.1). They were then given oral instructions regarding the use of the touch-screen computers and a basic overview of the test they were about to complete. They were also told that they could expectorate or swallow the wine samples.

Participants were assigned to individual partitioned taste booths for testing. All taste tests were conducted under white fluorescent light at room temperature ($70 \pm 2^\circ\text{F}$). The participants were first given a set of three Chardonnay samples of which two were the same and one was different. The participants were asked to indicate which one of the three samples they believed to be the odd sample. Upon completion of this task a five minute break ensued in order for them to cleanse their palate with the provided pectin rinse, cracker and water. After the five minute break, they were given a set of three Merlot samples. Again, two of these samples were the same and one was different. They were instructed to choose the

odd sample. The Chardonnay samples always preceded the Merlot samples. However, the order in which the samples were presented within the sample set was randomized every 10 participants. After the two triangle tests (Chardonnay and Merlot, respectively), the participants were asked seven demographic questions regarding their wine consumption habits such as the frequency of their red and white wine consumption, varieties of red and white wine they typically purchase, the price ranges of the red and white wine they typically purchase, and types of places they typically purchase their wine (Appendix 3.1). Participants were compensated ten dollars for their time and contribution.

3.5.2 Experiment 2 – Quality Assessment Test

The second experiment was split into two sessions. The participants were required to come to both sessions which were held one week apart.

Upon arrival for the first session, the participants were given oral instructions regarding use of the computers and an overview of the test and also asked to read and sign the informed consent forms (Appendix 2.2). In addition, they were informed that they had the option of expectorating or swallowing the wine samples.

Based on the results from the difference tests (discussion to follow), it was determined that it was necessary for the participants to taste one Chardonnay sample and one Merlot sample in the first session. The type

of closure sample for both Chardonnay and Merlot samples was rotated every ten participants so that participants rated the same closure type for both Chardonnay and Merlot and each closure type was analyzed by at least 30 people. This order was chosen for ease of preparation with the sensory facility's capacity of ten booths.

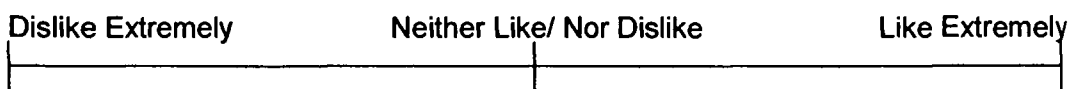
Participants were assigned to individual partitioned taste booths for testing. All taste tests were conducted under white fluorescent light at room temperature ($70 \pm 2^\circ\text{F}$). The subjects were given the Chardonnay sample first. They were first asked to evaluate how much they liked the wine sample on a 10 cm line scale (Figure 3.1).

Figure 3.1 10 cm Line Scale Assessing Liking Rating



They were then asked to rate their opinion of the overall quality of the wine on a 10 cm line scale (Figure 3.2).

Figure 3.2 10 cm Line Scale Assessing Quality Rating



Next, they were asked if they would consider buying a wine like the sample they tasted. Finally, they were asked to specify a price range they would expect to pay for a wine like the one they tasted (Appendix 3.2.1). The price ranges were determined through collaboration with Hogue Cellar's Marketing team. Following the completion of this question, a five minute break ensued in order for the subjects to rinse with the pectin solution, eat the cracker and drink the water in order to cleanse their palettes. After their five minute break, they were given the Merlot sample. They were asked the exact same questions as for the Chardonnay sample. Following the completion of the questions -related to tasting the samples, they were asked nine demographic questions (Appendix 3.2.1). Seven of these questions were the same as those asked in the triangle tests. The other two were regarding the age and gender of the participants. The participants were compensated at the end of the second session of this experiment.

One week after the first session, the same participants returned to complete the second session. They were again given an overview of the test. Also, any questions they had were answered. They were told that in this session, they would be given photographs along with each of the wine samples. They were instructed to consider the information learned from these photos when they were answering the questions regarding each of the wine samples they tasted. They were also instructed that following the sixth sample, there would be a question that would require the use of a

paper ballot. In this session the subjects were given all six samples monadically. Again, the Chardonnay samples were always given before the Merlot samples. The order of presentation was randomized every ten subjects. The same questions as in the first session were presented with each sample (Appendix 3.2.2). In addition, photographs of the bottle and closure were presented to the subjects when they were served the wine samples (Appendix 5). The photographs were pushed through the booth slots before the sample trays, in order to ensure that the subjects noticed and observed the photos. The onscreen instructions reminded them to first look at the photo for the particular sample. In addition, they were told that the wine sample they were tasting and evaluating came from a bottle with that type of closure. Finally, they were reminded to consider that information when answering all the questions pertaining to that particular sample. After each sample, a two minute break ensued in which the subjects were instructed to rinse with the pectin solution, eat the cracker and drink the water, in order to cleanse their palettes. The breaks were two minutes long in order to keep the test to an hour time frame. Once they had finished evaluating each of the six samples, they were asked a series of questions related to their opinions regarding synthetic corks and screw cap closures (Appendix 3.2.2). The majority of these questions were derived with the help of the Hogue Cellars staff. As previously mentioned, the first question after the last sample required the use of a paper ballot (Appendix 6). This was due to space constraints on the Compusense

computer screen. Therefore, the participants read each of the statements on the paper ballot and then marked on the computer screen which (if any) they believed to be true. Only three or four key words from each of the statements were placed next to the answer choice on the screen to verify they were marking the same statement as on the paper ballot. After they had completed the rest of the wine closure opinion questions (Appendix 3.2.2), they were compensated twenty-five dollars for their time and effort.

3.6 Data Analysis

3.6.1 Experiment 1 – Difference Tests

In order to determine the probability of obtaining the given result on the null hypothesis, that there is no difference between the two samples, both an established table (O'Mahony 1986) and Compusense results were used. To ensure that a difference between the wine closures is actually perceived by the consumers, $\alpha = 0.05$ was selected and a large number of participants (N) was used in each test. Descriptive statistics were used to determine the percentages of subjects in various subcategories. For the questions regarding the wine types typically consumed and the places where the consumers typically bought their wine, the participants were instructed to choose all that applied, therefore multiple answers were permitted. Therefore, the percentages of each category were calculated by dividing the answer count by the total number of participants in the particular test.

3.6.2 Experiment 2 – Quality Assessment Test

Descriptive statistics were used to evaluate the percentages of subjects in the various demographic categories and the wine consumption habit categories. The percentages were calculated in the same manner as in the Difference Test for the questions about the wine types typically consumed and places where wine was typically bought. The differences between the scores in the Closure Unknown condition (session 1) and Closure Known condition (session 2) were first determined for the 4 quality variables: Overall Liking, Quality Assessment, Purchase Intent and Purchase Price. For the Liking and Quality variables, t-test repeated measures statistics were calculated, as these variables were continuous. For the categorical variables, Purchase Intent and Purchase Price, the Wilcoxon Rank-Sum non-parametric tests were used.

A one-way analysis of variance (ANOVA) was conducted to evaluate the magnitude of the differences between the Unknown and Known scores among the three closure types. The independent variable, the closure type, included three types: Natural Cork, Synthetic Cork and Screw Cap. The dependent variable was the change in scores from the first week to the second week.

Tukey's HSD, a follow-up post hoc statistic test, was conducted for the one-way ANOVAs that were statistically significant in order to determine the specific differences among the three closure type.

For the closure attitude results, descriptive statistics were used to find the percentages of subjects that were in the 'disagree' or 'agree' categories. Although there were seven possible answers for the closure attitude questions, the results were grouped into the following three categories: 'disagree', 'neither disagree nor agree' and 'agree'. For the 'disagree' category the results from 'strongly disagree', 'disagree' and 'slightly disagree' were grouped. For the 'agree' category the results from 'strongly agree', 'agree' and 'slightly agree' were grouped.

4. Results

4.1 Experiment 1 – Difference Tests

4.1.1 Screw Cap versus Natural Cork

For the Chardonnay samples, 26 participants out of a total of 64 correctly identified the odd sample ($p = .135$). Of the 64 participants, 26 correctly identified the odd Merlot sample. However, in the second testing session, the Natural Cork sample had cork taint. Therefore, these results were removed from the analysis. Thus, 21 out of 57 participants correctly identified the odd Merlot sample ($p \sim .35$). Thus, for both Chardonnay and the Merlot varietals, the participants could not significantly detect a difference between the Screw Cap and Natural Cork samples. Tables 4.1 – 4.7 show the results of the wine consumption habits of these sixty-four participants.

Table 4.1 Screw Cap versus Natural Cork Test Participants' Frequency of Drinking White Wine (N=64)

More than 3 times a Week	1	1.6%
Weekly	13	20.3%
2-3 times a Month	28	43.8%
Once a Month	8	12.5%
Less than Once a Month	8	12.5%
Special Occasions	4	6.3%
Never	2	3.1%

Table 4.2 Screw Cap versus Natural Cork Test Participants' Frequency of Drinking Red Wine

More than 3 times a Week	8	12.5%
Weekly	21	32.8%
2-3 times a Month	17	26.6%
Once a Month	12	18.8%
Less than Once a Month	2	3.1%
Special Occasions	4	6.3%
Never	0	-

Table 4.3 Screw Cap versus Natural Cork Test Participants' Types of White Wine Typically Purchased and Consumed

Chardonnay	38	59.4%
Pinot Gris (Grigio)	27	42.2%
Riesling	26	40.6%
Sauvignon Blanc	16	25.0%
Gewurztraminer	12	18.8%
Other	9	14.1%
Unsure	9	14.1%
Pinot Blanc	8	12.5%
Blends	7	10.9%
I don't drink white wine.	0	-

Table 4.4 Screw Cap versus Natural Cork Test Participants' Types of Red Wine Typically Purchased and Consumed

Merlot	43	67.2%
Cabernet Sauvignon / Bordeaux	39	60.9%
Pinot noir / Burgundy	20	31.2%
Blends	16	25.0%
Zinfandel	12	18.8%
Other	10	15.6%
Unsure	6	9.4%
I don't drink red wine.	1	1.6%

Table 4.5 Screw Cap versus Natural Cork Test Participants' Typical Price Range Paid for a White Wine Bottle

\$5 and UNDER	7	10.9%
\$6-10	32	50.0%
\$11-15	18	28.1%
\$16-20	3	4.7%
\$20-30	0	-
Over \$30	0	-
I don't buy red wine.	4	6.3%

Table 4.6 Screw Cap versus Natural Cork Test Participants' Typical Price Range Paid for a Red Wine Bottle

\$5 and UNDER	8	12.5%
\$6-10	32	50.0%
\$11-15	17	26.6%
\$16-20	3	4.7%
\$20-30	2	3.1%
Over \$30	0	-
I don't buy red wine.	2	3.1%

Table 4.7 Screw Cap versus Natural Cork Test Participants' Typical Location for Purchasing Wine

Grocery Store	62	96.9%
Restaurant	24	37.5%
Bar	17	26.6%
Wine Shop	16	25.0%
Club Store (Ex. CostCo)	9	14.1%
Convenience Store	7	10.9%
Other	5	7.8%
Internet Shopping	1	1.6%

The majority of the participants in this test indicated that they drink white and red wine at least 2-3 times a month. Approximately 60% typically consume Chardonnay and 67% typically consume Merlot. Approximately 78% pay between \$6-15 for a bottle of white and red wine. The majority typically purchase their wines at grocery stores.

4.1.2 Screw Cap versus Synthetic Cork

Out of a total of 73 participants, 27 were able to correctly identify the odd Chardonnay sample ($p = .292$). For the Merlot samples, 25 out of the 73 total participants were able to correctly identify the odd sample ($p = .478$). Therefore, the participants could not significantly detect a difference

between the two closure types for both the Chardonnay and the Merlot samples. Tables 4.8 – 4.14 give the results of the wine consumption habits of these seventy-three participants.

Table 4.8 Screw Cap versus Synthetic Cork Test Participants' Frequency of Drinking White Wine

More than 3 times a Week	7	9.6%
Weekly	16	21.9%
2-3 times a Month	19	26.0%
Once a Month	16	21.9%
Less than Once a Month	5	6.9%
Special Occasions	10	13.7%
Never	0	-

Table 4.9 Screw Cap versus Synthetic Cork Test Participants' Frequency of Drinking Red Wine

More than 3 times a Week	18	24.7%
Weekly	24	32.9%
2-3 times a Month	24	32.9%
Once a Month	3	4.1%
Less than Once a Month	3	4.1%
Special Occasions	1	1.4%
Never	0	-

Table 4.10 Screw Cap versus Synthetic Cork Test Participants' Types of White Wine Typically Purchased and Consumed

Chardonnay	42	57.5%
Riesling	28	38.4%
Pinot Gris (Grigio)	26	35.6%
Sauvignon Blanc	24	32.9%
Pinot Blanc	11	15.1%
Blends	11	15.1%
Gewurztraminer	10	13.7%
Other	10	13.7%
Unsure	6	8.2%
I don't drink white wine.	0	-

Table 4.11 Screw Cap versus Synthetic Cork Test Participants' Types of Red Wine Typically Purchased and Consumed

Merlot	50	68.5%
Cabernet Sauvignon / Bordeaux	44	60.3%
Pinot noir / Burgundy	30	41.1%
Zinfandel	22	30.1%
Blends	22	30.1%
Other	13	17.8%
Unsure	3	4.1%
I don't drink red wine.	0	0%

Table 4.12 Screw Cap versus Synthetic Cork Test Participants' Typical Price Range Paid for a White Wine Bottle

\$5 and UNDER	5	6.9%
\$6-10	40	54.8%
\$11-15	14	19.2%
\$16-20	8	11.0%
\$20-30	0	0.0%
Over \$30	0	-
I don't buy red wine.	6	8.2%

Table 4.13 Screw Cap versus Synthetic Cork Test Participants' Typical Price Range Paid for a Red Wine Bottle

\$5 and UNDER	10	13.7%
\$6-10	31	42.5%
\$11-15	22	30.1%
\$16-20	6	8.2%
\$20-30	3	4.1%
Over \$30	0	-
I don't buy red wine.	1	1.4%

Table 4.14 Screw Cap versus Synthetic Cork Test Participants' Typical Location for Purchasing Wine

Grocery Store	69	94.5%
Wine Shop	28	38.4%
Restaurant	25	34.2%
Bar	11	15.1%
Club Store (Ex. Costco)	9	12.3%
Other	8	11%
Convenience Store	6	8.2%
Internet Shopping	2	2.7%

More than half of the participants in this test specified that they drink white wine at least 2-3 times a month. A large majority (90%) indicated that they drink red wine at least 2-3 times per month. Chardonnay and Merlot were the two wine types that the participants indicated they typically drink the most. The majority of the panelists pay between \$6-15 for a bottle of wine. The grocery store was the place the majority of the participants indicated they typically purchase wine.

4.1.3 Natural Cork vs. Synthetic Cork

Twenty-four out of a total of sixty-seven participants correctly identified the odd Chardonnay sample ($p = .376$). For the Merlot samples, 19 out of 67 participants correctly identified the odd sample ($p = 0.840$). As with the other two triangle tests, the participants could not significantly determine a difference between the two closure types for either the Chardonnay or the Merlot samples. Tables 4.15 – 4.21 give the results for these sixty seven participants' wine consumption habits.

Table 4.15 Natural Cork versus Synthetic Cork Test Participants' Frequency of Drinking White Wine

More than 3 times a Week	1	1.5%
Weekly	9	13.4%
2-3 times a Month	21	31.3%
Once a Month	13	19.4%
Less than Once a Month	12	17.9%
Special Occasions	10	14.9%
Never	1	1.5%

Table 4.16 Natural Cork versus Synthetic Cork Test Participants' Frequency of Drinking Red Wine

More than 3 times a Week	4	6.0%
Weekly	27	40.3%
2-3 times a Month	23	34.3%
Once a Month	6	9.0%
Less than Once a Month	3	4.5%
Special Occasions	4	6.0%
Never	0	0.0%

Table 4.17 Natural Cork versus Synthetic Cork Test Participants' Types of White Wine Typically Purchased and Consumed

Chardonnay	35	52.2%
Pinot Gris (Grigio)	33	49.3%
Riesling	23	34.3%
Sauvignon Blanc	16	23.9%
Pinot Blanc	15	22.4%
Gewurztraminer	13	19.4%
Blends	6	9.0%
Unsure	3	4.5%
I don't drink white wine.	2	3.0%
Other	0	0.0%

Table 4.18 Natural Cork versus Synthetic Cork Test Participants' Types of Red Wine Typically Purchased and Consumed

Merlot	44	65.7%
Cabernet Sauvignon / Bordeaux	42	62.7%
Pinot noir / Burgundy	35	52.2%
Blends	16	23.9%
Other	10	14.9%
Zinfandel	7	10.4%
Unsure	2	3.0%
I don't drink red wine.	0	0.0%

Table 4.19 Natural Cork versus Synthetic Cork Test Participants' Typical Price Range Paid for a White Wine Bottle

\$5 and UNDER	8	11.9%
\$6-10	32	47.8%
\$11-15	17	25.4%
\$16-20	4	6%
\$20-30	1	1.5%
Over \$30	0	0.0%
I don't buy red wine.	5	7.5%

Table 4.20 Natural Cork versus Synthetic Cork Test Participants' Typical Price Range Paid for a Red Wine Bottle

\$5 and UNDER	2	3.0%
\$6-10	41	61.2%
\$11-15	16	23.9%
\$16-20	5	7.5%
\$20-30	3	4.5%
Over \$30	0	0.0%
I don't buy red wine.	0	0.0%

Table 4.21 Natural Cork versus Synthetic Cork Test Participants' Typical Location for Purchasing Wine

Grocery Store	59	88.1%
Restaurant	33	49.3%
Wine Shop	18	26.9%
Bar	13	19.4%
Club Store (Ex. CostCo)	11	16.4%
Convenience Store	4	6.0%
Other	4	6.0%
Internet Shopping	1	1.5%

4.2 Experiment 2 – Quality Assessment Test

Table 4.22 shows the demographic results for the 106 participants that participated in both sessions of the quality assessment tests.

Table 4.22 Quality Assessment Test Consumer Demographics

Gender		
Male	40	37.7%
Female	66	62.3%
Age		
21-24	20	18.9%
25-35	47	44.3%
36-45	10	9.4%
46-55	19	17.9%
56-65	10	9.4%

Tables 4.23 – 4.29 give the results for the wine consumption habits of the participants that participated in both sessions of the tests.

Table 4.23 Quality Assessment Test Participants' Frequency of Drinking White Wine

More than 3 times a Week	4	3.8%
Weekly	30	28.3%
2-3 times a Month	38	35.8%
Once a Month	20	18.9%
Less than Once a Month	12	11.3%
Special Occasions	2	1.9%
Never	0	0.0%

Table 4.24 Quality Assessment Test Participants' Frequency of Drinking Red Wine

More than 3 times a Week	14	13.2%
Weekly	43	40.6%
2-3 times a Month	33	31.1%
Once a Month	10	9.4%
Less than Once a Month	5	4.7%
Special Occasions	1	0.9%
Never	0	0.0%

Table 4.25 Quality Assessment Test Participants' Types of White Wine Typically Purchased and Consumed

Chardonnay	64	60.4%
Riesling	52	49.1%
Pinot Gris (Grigio)	49	46.2%
Sauvignon Blanc	33	31.1%
Gewurztraminer	20	18.9%
Pinot Blanc	17	16.0%
Other	14	13.2%
Blends	13	12.3%
Unsure	6	5.7%
I don't drink white wine.	1	0.9%

Table 4.26 Quality Assessment Test Participants' Types of Red Wine Typically Purchased and Consumed

Merlot	78	73.6%
Cabernet Sauvignon / Bordeaux	62	58.5%
Pinot noir / Burgundy	55	51.9%
Blends	30	28.3%
Other	28	26.4%
Zinfandel	25	23.6%
Unsure	1	0.9%
I don't drink red wine.	0	0.0%

Table 4.27 Quality Assessment Test Participants' Typical Price Range Paid for a White Wine Bottle

\$5 and UNDER	10	9.4%
\$6-10	63	57.5%
\$11-15	30	27.4%
\$16-20	3	2.8%
\$20-30	1	0.9%
Over \$30	0	0.0%
I don't buy red wine.	2	1.9%

Table 4.28 Quality Assessment Test Participants' Typical Price Range Paid for a Red Wine Bottle

\$5 and UNDER	11	10.4%
\$6-10	59	55.7%
\$11-15	31	29.2%
\$16-20	3	2.8%
\$20-30	2	1.9%
Over \$30	0	0.0%
I don't buy red wine.	0	0.0%

Table 4.29 Quality Assessment Test Participants' Typical Location for Purchasing Wine

Grocery Store	99	93.4%
Restaurant	44	41.5%
Wine Shop	34	32.1%
Bar	28	26.4%
Winery	26	24.5%
Club Store (Ex. CostCo)	21	19.8%
Convenience Store	7	6.6%
Other	2	1.9%
Internet Shopping	0	0.0%

A large percent of the participants indicated that they drink white wine at least 2-3 times per month. More than two thirds of the participants stated that they drink red wine at least 2-3 times a month. More than half of the participants typically drink Chardonnay and Merlot. The majority of the participants said that they pay between \$6-15 for a bottle of wine. The majority of the participants typically purchase wine at grocery stores.

4.2.1 Chardonnay Results

Table 4.30 gives the results of the one-way ANOVA which compares the magnitude of the differences between the UNKNOWN and KNOWN scores among the three closure types for the three Chardonnay samples.

Table 4.30 ANOVA Results for the Mean Differences between the UNKNOWN and KNOWN Scores (\pm standard deviation) for the 4 Quality Variables for the Chardonnay Samples

	Liking	Quality	Purchase Intent	Purchase Price
Natural Cork	-0.08 ± 2.40^a	0.33 ± 2.14^a	0.01 ± 1.35^a	0.38 ± 1.52^a
Synthetic Cork	-0.49 ± 2.66^a	-0.09 ± 2.15^a	$-0.10 \pm 1.43^{a,b}$	0.22 ± 1.43^a
Screw Cap	-0.74 ± 2.78^a	-1.07 ± 2.23^b	-0.54 ± 1.54^b	-0.55 ± 1.40^b
F (2, 315)	1.723	11.476	4.264	12.457
Significant (p-value)	Not Sig. (p=.18)	Sig. (p < .01)	Sig. (p = .015)	Sig. (p < .01)

a, b. Differing superscript letters indicate significantly different results.

Tukey's HSD, the follow-up test statistic, was used to evaluate pairwise differences among the three closure types for the significant

results, these differences are indicated by the superscript letters in Table 4.30. For the Quality scores, the Screw Cap score was significantly lower than the Natural Cork, $p < .01$ and the Screw Cap score was also significantly lower than the Synthetic Cork score, $p < .01$. However, the Synthetic Cork and the Natural Cork Quality scores did not significantly differ from one another, $p = .671$.

For the Purchase Intent scores the Screw Cap Purchase Intent was significantly lower (less likely) than the Natural Cork, $p = .02$. However, the Purchase Intent for the Synthetic Cork and the Screw Cap did not significantly differ from one another at $\alpha = 0.05$, $p = .074$, nor did the Synthetic Cork and the Natural Cork, $p = .835$.

For Purchase Price, participants indicated the price they were willing to pay for the Screw Cap was significantly lower than the price for the Natural Cork, $p < .01$. Also, the price they were willing to pay for the Screw Cap was significantly lower than for the Synthetic Cork, $p < .01$. Purchase Price for the Natural Cork and the Synthetic Cork samples did not significantly differ from one another, $p = .710$.

Tables 4.31 – 4.34 show the results of the comparison of the differences between the UNKNOWN and KNOWN scores for the four quality assessment variables: Liking, Quality, Purchase Intent and Purchase Price for the Chardonnay closure samples. The names of these variables are derived from the four questions from which they are measured, as described previously in the Materials and Methods chapter.

Table 4.31 Comparison of the Mean UNKNOWN to KNOWN Liking Scores for the Each of the Chardonnay Closure Type Samples

	Mean Liking Score, N=106	t-value *	Significant (p-value)
UNKNOWN	6.10 ± 1.92	-	-
KNOWN – Natural Cork	6.02 ± 1.92	t (105)= 0.324	Not Sig. (p= 0.747)
KNOWN – Synthetic Cork	5.61 ± 1.88	t (105)= 1.913	Not Sig. (p= 0.058)
KNOWN – Screw Cap	5.36 ± 1.98	t (105)= 2.720	Sig. (p < .01)

* Results obtained using Repeated-Measures t-Test

Table 4.32 Comparison of the Mean UNKNOWN to KNOWN Quality Scores for the Chardonnay Samples

	Mean Quality Score, N = 106	t-value *	Significant (p-value)
UNKNOWN	5.66 ± 1.60	-	-
KNOWN – Natural Cork	5.99 ± 1.57	t (105)= -1.585	Not Sig. (p= 0.116)
KNOWN – Synthetic Cork	5.57 ± 1.69	t (105)= 0.415	Not Sig. (p= 0.679)
KNOWN – Screw Cap	4.59 ± 1.94	t (105)= 4.912	Sig. (p < .01)

* Results obtained using Repeated-Measures t-Test

Table 4.33 Comparison of the Mean UNKNOWN to KNOWN Purchase Intent Scores for the Chardonnay Samples

	Mean Purchase Intent Score, N = 106	Equivalent Category	Z-score *	Significant (p-value)
UNKNOWN	3.18 ± 0.98	Might NOT buy/Might buy	-	-
KNOWN – Natural Cork	3.19 ± 1.05	Might NOT buy/Might buy	Z = -0.169 ^a	Not Sig. (p= 0.866)
KNOWN – Synthetic Cork	3.08 ± 1.11	Might NOT buy/Might buy	Z = -0.760 ^a	Not Sig. (p= 0.447)
KNOWN – Screw Cap	2.64 ± 1.125	Would PROBABLY NOT buy – Might NOT buy	Z = -3.394 ^a	Sig. (p < .01)

* Results obtained using Wilcoxon Rank-Sum

a. Based on positive ranks. (There are fewer positive ranks (# KNOWN > # UNKNOWN) than negative ranks (# KNOWN < # UNKNOWN).)

Table 4.34 Comparison of the Mean UNKNOWN to KNOWN Purchase Price Scores for the Chardonnay Samples

	Mean Purchase Price Score, N = 106	Equivalent Category	Z-score	Significant (p-value)
UNKNOWN	2.21 ± 1.10	~\$8	-	-
KNOWN – Natural Cork	2.59 ± 1.31	~\$9	Z = -2.639 ^b	Sig. (p < .01)
KNOWN – Synthetic Cork	2.42 ± 1.39	~\$9	Z = -1.351 ^b	Not Sig. (p = .177)
KNOWN – Screw Cap	1.66 ± 1.06	~\$7	Z = -4.148 ^a	Sig. (p < .01)

* Results obtained using Wilcoxon Rank-Sum

a. Based on positive ranks. (There are fewer positive ranks (# KNOWN > # UNKNOWN) than negative ranks (# KNOWN < # UNKNOWN).)

b. Based on negative ranks. (There are fewer negative ranks (#KNOWN < # UNKNOWN) than positive ranks (#KNOWN > # UNKNOWN).)

4.2.2 Merlot Results

Table 4.35 gives the results of the one-way ANOVA which compares the magnitude of the differences between the UNKNOWN and KNOWN scores among the three closure types for the three Chardonnay samples.

Table 4.35 ANOVA Results for the Mean Differences between the UNKNOWN and KNOWN Scores (\pm standard deviation) for the 4 Quality Variables for the Merlot Samples

	Liking	Quality	Purchase Intent	Purchase Price
Natural Cork	0.29 ± 2.98^a	0.86 ± 2.63^a	0.21 ± 1.55^a	0.49 ± 1.81^a
Synthetic Cork	0.16 ± 3.16^a	$0.52 \pm 2.87^{a,b}$	0.11 ± 1.60^a	0.28 ± 1.83^a
Screw Cap	-0.34 ± 2.91^a	-0.26 ± 2.72^b	-0.28 ± 1.57^a	-0.42 ± 1.68^b
F (2, 315)	1.265	4.666	2.895	7.749
Significant (p-value)	Not Sig. ($p = .284$)	Sig. ($p = .01$)	Not Sig. ($p = .057$)	Sig. ($p < .01$)

a, b. Differing superscript letters indicate significantly different results.

Again, Tukey's HSD was used to as the follow-up test statistic in order to further evaluate the specific pairwise differences among means of the three closure types for the Merlot samples for significant results. As indicated with the superscript letters in Table 4.35, there were significant differences in means between the Screw Cap and the Natural Cork, $p < .01$ for the Quality scores. However, the Screw Cap and the Synthetic Cork did not significantly differ, $p = .09$, nor did the Synthetic Cork and the Natural Cork, $p = 0.65$.

For the Purchase Price scores, consumers were willing to pay significantly less for the Screw Cap than the Natural Cork, $p < .01$, and also significantly less for the Screw Cap than the Synthetic Cork samples, $p = .02$. However, the Purchase Price for Synthetic Cork and the Natural Cork samples did not significantly differ in magnitude, $p = 0.716$.

Tables 4.36 – 4.39 provide the results for the comparison of the differences between the UNKNOWN and the KNOWN scores for the four quality assessment variables for the Merlot samples.

Table 4.36 Comparison of the Mean UNKNOWN to KNOWN Liking Scores for the Each of the Merlot Closure Type Samples

	Mean Liking Score, N = 106	t-value *	Significant (p-value)
UNKNOWN	5.41 ± 2.59	-	-
KNOWN – Natural Cork	5.69 ± 2.34	t (105)= -0.987	Not Sig. (p= 0.326)
KNOWN – Synthetic Cork	5.57 ± 2.37	t (105)= -0.548	Not Sig. (p= 0.585)
KNOWN – Screw Cap	5.07 ± 2.16	t (105)= 1.185	Not Sig. (p= 0.239)

* Results obtained using t-Test Repeated-Measures

Table 4.37 Comparison of the Mean UNKNOWN to KNOWN Quality Scores for the Merlot Closure Type Samples

	Mean Quality Score, N = 106	t-value *	Significant (p-value)
UNKNOWN	5.02 ± 2.35	-	-
KNOWN – Natural Cork	5.87 ± 2.01	t (105)= -3.353	Sig. (p < .01)
KNOWN – Synthetic Cork	5.54 ± 2.12	t (105)= -1.877	Not Sig. (p= 0.063)
KNOWN – Screw Cap	4.75 ± 1.96	t (105)= 0.999	Not Sig. (p= 0.320)

* Results obtained using t-Test Repeated-Measures

Table 4.38 Comparison of the Mean UNKNOWN to KNOWN Purchase Intent Scores for the Merlot Closure Type Samples

	Mean Purchase Intent Score, N = 106	Equivalent Category	Z-score *	Significant (p-value)
UNKNOWN	2.85 ± 1.30	Might NOT buy	-	-
KNOWN – Natural Cork	3.06 ± 1.20	Might NOT buy/Might buy	Z = -1.206 ^b	Not Sig. (p= 0.228)
KNOWN – Synthetic Cork	2.96 ± 1.29	Might NOT buy/Might buy	Z = -0.714 ^b	Not Sig. (p= 0.475)
KNOWN – Screw Cap	2.57 ± 1.11	Would PROBABLY NOT buy – Might NOT buy	Z = -1.792 ^a	Not Sig. (p= 0.073)

* Results obtained using Wilcoxon Rank-Sum

a. Based on positive ranks. (There are fewer positive ranks (# KNOWN > # UNKNOWN) than negative ranks (# KNOWN < # UNKNOWN).)

b. Based on negative ranks. (There are fewer negative ranks (# KNOWN < # UNKNOWN) than positive ranks (# KNOWN > # UNKNOWN).)

Table 4.39 Comparison of the Mean UNKNOWN to KNOWN Purchase Price Scores for the Merlot Closure Type Samples

	Mean Purchase Price Score, N = 106	Equivalent Category	Z-score *	Significant (p-value)
UNKNOWN	2.38 ± 1.55	~\$9	-	-
KNOWN – Natural Cork	2.87 ± 1.65	~\$10	Z = -2.641 ^b	Sig. (p < .01)
KNOWN – Synthetic Cork	2.66 ± 1.44	~\$9-10	Z = -1.524 ^b	Not Sig. (p= 0.128)
KNOWN – Screw Cap	1.95 ± 1.41	~\$8	Z = -2.603 ^a	Sig. (p < .01)

* Results obtained using Wilcoxon Rank-Sum

a. Based on positive ranks. (There are fewer positive ranks (# KNOWN > # UNKNOWN) than negative ranks (# KNOWN < # UNKNOWN).)

b. Based on negative ranks. (There are fewer negative ranks (# KNOWN < # UNKNOWN) than positive ranks (# KNOWN > # UNKNOWN).)

4.2.3 Closure Related Issues and Attitude Results

Table 4.40 displays the percentages of consumers who believed the various statements regarding issues related to wine bottle closures were true.

Table 4.40 Quality Assessment Test Participants' Knowledge of Closure Related Issues

	% Believe True
Natural corks are used in wine because of its tradition.	84.9%
Synthetic/plastic corks are used in wines because they're cheaper than natural corks.	55.7%
Screw caps are used in wines because they're cheaper than natural corks.	78.3%
Natural corks indicate high wine quality.	46.2%
Synthetic/plastic corks indicate high wine quality.	17%
Screw caps indicate high wine quality.	0.9%
Natural corks can sometimes cause wines to smell and taste bad.	23.6%
Synthetic/plastic corks can sometimes cause wines to smell and taste bad.	10.4%
Screw caps can sometimes cause wines to smell and taste bad.	19.8%
Synthetic/plastic corks prevent spoilage that has been associated with natural corks.	54.7%
Screw caps prevent spoilage that has been associated with natural corks.	31.1%
Synthetic/plastic corks are acceptable substitutes for natural corks.	72.6%
Screw caps are acceptable substitutes for natural corks.	20.8%
Natural corks preserve wines better than synthetic/plastic corks.	17.9%
Natural corks preserve wines better than screw caps	50%
Synthetic/plastic corks preserve wines better than natural corks.	34.9%
Synthetic/plastic corks preserve wines better than screw caps.	38.7%
Screw caps preserve wines better than natural corks.	16%
Screw caps preserve wines better than synthetic/plastic corks.	7.5%

Table 4.41 gives the results for the participants' attitude toward the closures, particularly the synthetic corks and the screw caps.

Table 4.41 Quality Assessment Test Participants' Closure Attitude Results

	Disagree	Neither Disagree Nor Agree	Agree
I would buy a wine with a synthetic cork.	13.2%	3.8%	83%
I would buy a wine with a screw cap.	52.8%	13.2%	34%
I believe that wines with synthetic corks are higher in quality than those with natural corks.	51.9%	34.9%	13.2%
I believe that wines with screw caps are higher in quality than those with natural corks.	88.7%	6.6%	4.7%
I would be disappointed if I bought a wine at a restaurant and it came back with a synthetic cork.	64.2%	9.4%	26.4%
I would be disappointed if I bought a wine at a restaurant and it came back with a screw cap.	16%	3.8%	80.2%
In a restaurant, I would send back a wine that came out with a synthetic cork.	86.8%	7.5%	5.7%
In a restaurant, I would send back a wine that came out with a screw cap.	33%	12.3%	54.7%

5. Discussion

5.1 Experiment 1 – Difference Tests

5.1.1 Screw Cap versus Natural Cork

As shown in the previous chapter, the participants could not significantly detect a difference between the Screw Cap and Natural Cork samples for both the Chardonnay and the Merlot varietals. Again, the participants were given the three samples blind, without any information given regarding the type of white or red wine or the type of bottle closure. The participants were not given any indication regarding the purpose of the difference test. Therefore this result is based only on subjects' response to the wine samples' sensory properties.

These participants were frequent red and white wine consumers. Tables 4.1 and 4.2 show that 65.6% of the participants indicated that they drink white wine at least two to three times a month and 71.9% stated that they drink red wine at least two to three times a month. Although they were not given information regarding the type of wines they tasted, the results concerning their wine consumption habits revealed that they were familiar with the two sample types; as seen in Tables 4.3 and 4.4, 59.4% typically purchased and drank Chardonnay and 67.2% typically purchased and drank Merlot. Also, the participants typically bought red and white wines in the price ranges of the two samples' retail prices (\$9 for the Chardonnay and \$15 for the Merlot). Tables 4.5 and 4.6 show that 78.1%

of the participants typically pay between \$6–15 for white wine and 76.6% typically pay between \$6-15 for red wine. These results confirm that participants selected as subjects for this test represented the target consumer audience for these wines.

5.1.2 Screw Cap versus Synthetic Cork

The participants for this triangle test were also unable to significantly determine a difference between the two closure type samples based only on the sensory properties: taste, aroma, appearance and mouthfeel. They too were frequent red and white wine consumers; with 57.5% who drank white wine at least two to three times a month and 90.4% consumed red wine no less than two to three times a month. They were also familiar with Chardonnay (57.5% were regular consumers) and with Merlot (68.5% regularly purchased and consumed it). 74% of these participants typically paid between \$6-15 for a bottle of white wine and 72.6% paid the same price range for a bottle of red wine. Therefore, this group of participants was also the target consumer audience for this difference test.

5.1.3 Natural Cork versus Synthetic Cork

The large p-values for this difference test indicate that these participants could not significantly detect a difference between the two closure type samples. Again, the results from the wine consumption habit questions revealed that the target consumer audience for this test was

found. For the frequency of consuming white and red wine, Tables 4.15 and 4.16 show that 46.3% of the participants consumed white wine at least 2-3 times a month and 80.6% drank red wine as a minimum 2-3 times a month. These participants were also familiar with the Chardonnay and Merlot samples, as 52.2% and 65.7%, respectively, typically purchased and consumed them. They also typically paid similar price ranges for white and red wine; 73.1% typically paid \$6-15 for a bottle of white wine and 85.1% typically paid that same range for red wine.

5.1.4 Summary

The results of all three triangle tests reveal that the participants are unable to determine a significant difference among the wines bottled with each of the three closures types based only on the sensory attributes of the wines. Therefore, any difference in the quality variables in the second session of the quality assessment test (when the closure types are KNOWN) from the first session (when the closure types are UNKNOWN) are based on the opinions of the wine drawn from the closure type.

5.2 Experiment 2 – Quality Assessment Test

The results for the wine consumption habits reveal that the participants for the quality assessment test were frequent white and red wine consumers. 67.9% of the consumers drank white wine at least 2-3 times a month while 84.9% drank red wine at least that same amount. Like

the Difference Test participants, they too were familiar with Chardonnay and Merlot wines as 60.4% typically bought and consumed Chardonnay and 87.7% typically purchased Merlot. 87.7% typically paid between \$6-15 for a bottle of white wine and 84.9% typically paid that same range for a bottle of red wine; therefore, they purchased wine in the same price ranges as the retail price of the sample wine.

5.2.1 Chardonnay

The one-way ANOVA comparing the magnitude of the differences between the UNKNOWN and KNOWN Liking scores among the three closure types for the Chardonnay samples was not significant, $F(2, 315) = 1.723$, $p = 0.180$. Thus, change in the Liking score between the UNKNOWN and KNOWN sessions for the Natural Cork (-0.08 ± 2.40) was not greater than the change for either the Synthetic Cork (-0.49 ± 2.66) or the Screw Cap (-0.74 ± 2.78).

In order to determine if the change in scores from the UNKNOWN session to the KNOWN session was significantly different from zero, Repeated Measures *t*-tests were conducted. The consumers did not significantly change their opinions of how much they liked the Natural Cork samples, as they were not significant, $p = 0.747$. The Synthetic Cork scores were nearly significant, $p = .058$. There was a slight decrease in scores once the closure type was known. However, when they learned that the wine sample had a screw cap they significantly reduce their Liking

score, $p < .01$. Thus, the consumers tend to slightly decrease their Liking scores if closures are synthetic and significantly decrease them for the Screw Cap wines.

For the Quality scores, the ANOVA comparing the magnitudes of the three closure type samples' means for the Quality scores was significant, $F(2, 315) = 11.476$, $p < .01$. Based on Tukey's HSD, a follow-up test statistic, the magnitude of the differences between the means for the Synthetic Cork and the Natural Cork samples did not significantly differ. However, there were significant differences in the magnitudes of the means between the Screw Cap and the Natural Cork, $p < .01$. Therefore, the negative change between the UNKNOWN and KNOWN scores for the Screw Cap sample (-1.07 ± 2.23) was greater than the slight change in score for the Natural Cork (0.33 ± 2.14). There were also significant differences in the magnitudes of the means between the Screw Cap and the Synthetic Cork, $p < .01$. Thus, the negative change in scores for the Screw Cap (-1.07 ± 2.23) was larger than the Synthetic Cork's slight change (-0.09 ± 2.15).

In order to determine if the changes in scores were significantly different than zero, the Repeated Measures t -test was conducted. As shown in Table 4.31, there was a significant difference between the mean UNKNOWN and KNOWN scores for only the Screw Cap samples, $p < .01$. Thus, the participants decreased their Quality scores when they were given the information that the wine sample came from a bottle with a screw cap.

This change in scores was due only to the information regarding the closure type, as the difference tests showed that the participants could not detect a difference between the sensory properties of the wines bottled with the three closure types.

The one-way ANOVA for the Purchase Intent scores was significant, $F(2, 315) = 4.264, p < .01$. Therefore, there were significant differences in the magnitudes of the difference scores among the three closure samples. Tukey's HSD test found that there were significant differences in means between the Screw Cap (-0.54 ± 1.54) and the Natural Cork (0.01 ± 1.35), $p = .02$. Therefore, the negative change in scores for the Screw Cap samples was significantly greater than the lack of change in scores found for the Natural Cork samples. However, the Synthetic Cork and the Screw Cap did not significantly differ at $\alpha = 0.05$, $p = .074$, nor did the Synthetic Cork and the Natural Cork, $p = .835$.

The Wilcoxon Rank-Sum results comparing the scores of the UNKNOWN and KNOWN sessions for the Purchase Intent scores can be seen in Table 4.33. It shows that only the difference score between the two sessions for the Screw Cap samples was significantly different than zero, $p < .01$, based on positive ranks. Therefore, the drop in Purchase Intent scores for the Screw Cap samples was significantly different than zero. In other words, the participants were less likely to purchase a wine like the samples with screw caps than when they tasted the wine without any closure information. The difference scores for the two cork samples did not

significantly differ, thus the participants did not alter their willingness to buy the sample based on the given closure information.

The one-way ANOVA for the Purchase Price scores was also significant, $F(2, 315) = 10.703, p < .01$. From Tukey's HSD, it was determined that there were significant differences in the magnitudes of the mean scores between the Screw Cap (-0.55 ± 1.40) and the Natural Cork (0.38 ± 1.52) samples, $p < .01$ and also between the Screw Cap (-0.55 ± 1.40) and the Synthetic Cork (0.22 ± 1.43) samples, $p < .01$. The difference between the mean scores for the Synthetic Cork and the Natural Cork samples was not significant, $p = 0.671$.

Finally, the Wilcoxon Rank-Sum results comparing the Purchase Price scores between the UNKNOWN and KNOWN sessions shown in Table 4.34 found that the difference scores for both the Natural Cork and the Screw Cap samples were significantly different than zero. The difference between the UNKNOWN and KNOWN scores for the Synthetic Cork samples was not significant. Therefore, when the participants were given information that the wine sample had a Natural Cork, they were willing to pay more for that bottle of wine. When told the sample came from a Synthetic Cork, they did not change the price they were willing to pay from their original price when the closure type was unknown. However, once they learned that the wine sample was bottled with a Screw Cap, they significantly lowered the price they were willing to pay for the

bottle of wine compared to the original price when the closure type was unknown.

5.2.2 Merlot

The one-way ANOVA conducted to compare the magnitude of the differences between the UNKNOWN and KNOWN Liking scores among the three closure types for the Merlot samples was not significantly different, $F(2, 315) = 1.265, p = .284$. Therefore, none of the scores were appreciably greater or lower than the others. The results for the Repeated Measures *t*-test comparing the differences between the mean Liking scores can be seen in Table 4.36. It shows that none of the differences for any of the samples were significantly different than zero. Thus, the participants did not significantly change their opinions of how much they liked the samples after they were given the information regarding the closure types for any of the samples.

The one-way ANOVA for the Quality scores was significant, $F(2, 315) = 4.67, p < .01$. The follow-up tests indicated that there were significant differences in the magnitude of the means between the Screw Cap (-0.26 ± 2.72) and the Natural Cork (0.86 ± 2.63) samples, $p < .01$. Therefore, the increase in Quality scores from UNKNOWN to KNOWN for the Natural Cork samples was significantly higher in magnitude than the decrease in scores from UNKNOWN to KNOWN for the Screw Cap samples. The participants increased their scores for the Natural Cork

samples while they lowered their Quality scores for the Screw Cap samples. However, the scores for the Screw Cap (-0.26 ± 2.72) and the Synthetic Cork (0.11 ± 2.87) samples did not differ, $p = 0.09$, nor did the Synthetic Cork (0.11 ± 2.87) and the Natural Cork (0.86 ± 2.63) samples, $p = 0.65$. Thus, the changes in scores between the Natural Cork and Synthetic Cork samples were not significantly different in magnitude, nor were the scores for the Synthetic Cork and the Screw Cap samples. The increase in difference scores for the Natural Cork samples was not significantly greater than the increase in scores for the Synthetic Cork samples. Although the Synthetic Cork scores increased and the Screw Cap scores decreased, the difference in magnitude between these scores was not significant. The Repeated Measures t -test results help to clarify these results. They confirm that neither changes in scores for the Synthetic Cork or the Screw Cap samples were significantly different than zero. In other words, the Synthetic Cork's Quality score did not significantly increase and the Screw Cap's score did not significantly decrease. Both changes in scores were close to zero.

The Repeated Measures t -test results, shown in Table 4.37, also indicated that for the Natural Cork samples the mean Quality score for the UNKNOWN session (5.02 ± 2.35) was significantly lower than the mean quality score for the KNOWN session (5.87 ± 2.01), $t(105) = -3.353$, $p < .01$. Therefore, when the participants were informed that the wine sample they tasted came from a bottle with a natural cork, they increased their

increased their Quality scores, indicating that they believed that this sample was of higher quality. The comparison of the two scores for the Synthetic Cork samples was not significant, $p = 0.063$, nor was the comparison of the Screw Cap scores significant, $p = .320$. Therefore, when the participants saw that the sample had a synthetic cork or a screw cap, they were not inclined to believe that the sample was of higher or lower quality than when the information regarding the closure type was not disclosed.

The one-way ANOVA for the Purchase Intent scores was not significant, $F(2, 315) = 2.895$, $p = .057$, at $\alpha = 0.05$. Thus, the difference scores among the three closure types were all similar in magnitude. As seen in Table 4.38, the Wilcoxon Rank-Sum results show that none of the differences between the UNKNOWN and KNOWN Purchase Intent scores was significantly different. Therefore, the consumers were just as likely to purchase any of the Merlot samples, regardless of the closure type.

The one-way ANOVA for the Purchase Price scores was significant, $F(2, 315) = 7.749$, $p < .01$. The follow-up results showed that there were significant differences between the magnitude in means for the Screw Cap (-0.42 ± 1.81) and Natural Cork (0.49 ± 1.81) samples, $p < .01$ and for the Screw Cap and Synthetic Cork (0.28 ± 1.83) samples, $p = .01$. The Natural Cork and Synthetic Cork samples did not significantly differ, $p = 0.671$. Therefore, both the Cork closure sample scores increase in price was greater than the Screw Cap scores decrease in price. The Wilcoxon Rank-

Sum results show whether the changes in scores were significant. These results can be seen in Table 4.39. The UNKNOWN score significantly differed from the KNOWN score for both the Natural Cork samples, $p < .01$, and for the Screw Cap samples, $p < .01$. The difference score for the Synthetic Cork sample was not significant. Therefore, when the participants knew that the wine came from a bottle with a natural cork, they significantly increased the price they would pay for the wine compared to when they were not given information about the closure. The wine consumers were willing to pay more for the bottle of wine, when the information about the natural cork closure was known. For the Screw Cap samples, they would not pay the same price for a screw cap wine compared to their original price when closure type was unknown and compared to the prices they were willing to pay for both types of cork closures. Thus, consumers would not pay as much for the wine when they knew it had a screw cap closure. When the panelists were given information that the wine had a synthetic cork, they did not change the price they would pay for it. Thus, it did not affect the purchase price of the wine.

5.2.3 Closure Related Issues and Attitudes

As seen in Table 4.40, there was a large majority of the consumers who believed that both synthetic corks and screw caps are used in wines because they are cheaper. A poll conducted by BRS Group, 2004,

confirms this result. They also found that consumers thought the reason the wine industry has started to use screw caps and other non-cork closures is to save money (Cartiere, 2004). Table 4.40 also shows that there was only a small percentage (23.6%) that had knowledge regarding the ill effects of natural corks and cork taint to wine. A small percentage also believed that screw caps can cause wines to taste and smell bad. Therefore, consumer education is needed regarding the issue of cork taint in wine due to natural corks and that the materials that screw caps are comprised of do not impart any sensory effects on the wine. They also should be given information about how screw caps prevent cork taint as only 31% of the participants believed that screw caps can prevent spoilage that has been associated with natural corks.

Table 4.41 gives the results of the consumers' attitudes towards the closures. The majority of the consumers looked favorably towards synthetic corks. Most (83%) indicated that they would buy a wine with a synthetic cork. A large portion (64.2%) said that they would not be disappointed if a wine came out with a synthetic cork at a restaurant. And the majority (86.8%) said that they would not send the wine back if it came out with a synthetic cork. Therefore, the results of the attitude portion of this study indicated that the synthetic cork was accepted by frequent consumers of wine.

The screw cap closures, however, did not receive such a favorable response. Only about one third of the consumers indicated that they would

buy a wine with a screw cap. The majority of the consumers (88.7%) believed that natural corks indicate a higher quality wine than wines bottled with screw caps. Most of the consumers (80.2%) answered that they would be disappointed if a wine came out in a restaurant with a screw cap. In addition, 54.7% said that they would be so disappointed that they would send the wine back at a restaurant because it had a screw cap.

6. Conclusions

6.1 Experiment 1 – Difference Tests

The consumers could not determine a difference between any of the three closure type sample based only on sensory stimuli.

6.2 Experiment 2 – Quality Assessment Test

6.2.1 Chardonnay

For the Chardonnay samples, when the consumers were given information that the sample came from a natural cork, they did not change their opinions of how much they liked the sample compared to when they did not have closure type information; nor did their opinions of its quality change. Similarly, the closure information did not affect their willingness to buy the sample. The price they were willing to pay for the sample did significantly increase from the UNKNOWN session to the KNOWN session. Also, it was significantly higher than the price the consumers were willing to pay for the Screw Cap sample for the KNOWN session.

The knowledge that the wine sample came from a synthetic cork did not affect the wine quality measurement scores when the closure information was revealed.

However, when it was revealed that the wine sample came from a screw cap bottle, the consumers liked the sample less, thought it was of lower quality, were less willing to buy a wine like the sample, and lowered the price they were willing to pay for the sample.

6.2.2 Merlot

The knowledge that the sample came from a natural cork, for the Merlot samples, caused the consumers to significantly change their opinions of the quality of the sample, from 'average' closer to 'high' quality. They were also willing to pay more for a bottle of wine when they were told the sample had a natural cork. The other two quality variables remained unchanged.

When the consumers were told that the wine samples had synthetic cork closures, they did not significantly increase or decrease any of their quality measurement scores.

For the Merlot Screw Cap samples, the closure type information affected the price consumers were willing to pay for the wine by approximately one dollar decrease.

6.2.3 Closure Related Issues and Attitudes

According to the results of the closure related issues questions, consumer education is needed regarding the issue of cork taint in wine due to natural cork and the resulting benefits of switching to screw caps.

The closure attitude questions revealed that in general, the consumers looked favorably towards synthetic corks. However, they did not look positively toward wine sealed with screw caps.

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Appendices

Please provide the following information about yourself. All information you provide is strictly confidential.

If you have participated in a consumer test with us this year, please indicate only new contact information

First Name _____ Last Name: _____ Gender: M _____ F _____

Address with Apt. #: _____

City: _____ State: _____ Zip code: _____

Day Phone: _____ Evening phone: _____ e-mail: _____

Best way and time to contact _____

Please indicate your age group.

18-20 _____ 21-24 _____ 25-35 _____ 36-45 _____ 4 6-55 _____ 56-65 _____ 66+ _____

Do you have any food allergies or dietary restrictions? No _____ If yes, please list _____

How frequently do you drink the following types of beverages?

	WEEKLY	2-3 TIMES A MONTH	ONCE A MONTH	LESS THAN ONCE A MONTH
Soda Pop	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sports Drinks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Milk	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Soy milk	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Orange Juice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Grape Juice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Apple Juice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cranberry Juice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bottled Water	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Coffee	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tea	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Red Wine	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
White Wine	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rose Wine	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Wine Coolers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Domestic Beers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Imported Beers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Microbrews	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mixed Alcoholic Drinks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

The Sensory Staff will get back to you to let you know if you have qualified for this test and schedule your test time accordingly. Please call with any questions or concerns at 503-872-6672.

FOOD INNOVATION CENTER EXPERIMENT STATION
COLLEGE OF AGRICULTURAL SCIENCES



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INFORMED CONSENT DOCUMENT

Project Title: Wine Difference Test

Principal Investigator: Anna B. Marin, Sensory Program Director, Food Innovation Center

Research Staff: Emily M. Jorgensen, Ann Colonna, Koei Kudo, Sun Lee

PURPOSE

This is a research study. The purpose of this research study is to determine if wine consumers can detect differences in different kinds of red and white wine varieties. The purpose of this consent form is to give you the information you will need to help you decide whether to be in the study or not. Please read the form carefully. You may ask any questions about the research, what you will be asked to do, the possible risks and benefits, your rights as a volunteer, and anything else about the research or this form that is not clear. When all of your questions have been answered, you can decide if you want to be in this study or not. This process is called “informed consent”. You will be given a copy of this form for your records.

We are inviting you to participate in this research study because you drink red and white wines. There are a total of 240 adults expected to participate in this study.

PROCEDURES

If you agree to participate, your involvement will last for approximately 20 minutes. The following procedures are involved in this study. You will be given instructions on how to take the test either on a computer or on a paper ballot. You will be assigned to go a tasting booth where you will be served a set of three 1 fluid ounce white wine samples each labeled with a random three-digit number. The wine used in this study is of the same quality that you would find in a grocery store or wine shop. Two of the samples will be the same, one will be different. Your task is to determine which of the samples is different from the other two. Following the set of white wines, you will be given a set of three red wine samples each labeled with a random three-digit number. Again, two of the samples will be the same and one will be different. Your task is the same, to identify the sample that is different out of the three.

RISKS

The risks involved in participating in this study are the same as consuming one glass of wine within an hour. You may drink the wine samples, or expectorate (spit out) them if you wish.

BENEFITS

There are no foreseeable personal benefits from participating in this study. The researchers anticipate that, in the future, society may benefit from this study by understanding consumer's perception of differences in types of red and white wines.

COSTS AND COMPENSATION

You will not have any costs for participating in this research project. You will be compensated for participating in this research project. At the end of the study, you will receive \$10 for completing all parts of the test. No compensation will be given unless the test is completed.

CONFIDENTIALITY

Records of participation in this research project will be kept confidential to the extent permitted by law. However, federal government regulatory agencies and the Oregon State University Institutional Review Board (a committee that reviews and approves research studies involving human subjects) may inspect and copy records pertaining to this research. It is possible that these records could contain information that personally identifies you. Coded names and identification numbers will be used to ensure confidentiality. In the event of any report or publication from this study, your identity will not be disclosed. Results will be reported in a summarized manner in such a way that you cannot be identified.

VOLUNTARY PARTICIPATION

Taking part in this research study is voluntary. You may choose not to take part at all. If you agree to participate in this study, you may stop participating at any time. You are free to skip any questions that you would prefer not to answer. If you decide not to take part, or if you stop participating at any time, your decision will not result in any penalty or loss of benefits to which you may otherwise be entitled. If you withdraw from the study before it is completed, the results you provide may be included in the study.

QUESTIONS

Questions are encouraged. If you have any questions about this research project, please contact: Anna Marin, 503-872-6654 and anna.marin@oregonstate.edu and/or Emily Jorgensen, 503-872-6658 and emily.jorgensen@oregonstate.edu. If you have questions about your rights as a participant, please contact the Oregon State University Institutional Review Board (IRB) Human Protections Administrator, at (541) 737-3437 or by e-mail at IRB@oregonstate.edu.

You may be contacted in the future to be part of other research studies. If you don't want to be contacted about future studies, just let one of the researchers know at any time.

Your signature indicates that this research study has been explained to you, that your questions have been answered, and that you agree to take part in this study. You will receive a copy of this form.

Participant's Name (printed):

(Signature of Participant)

(Date)

RESEARCHER STATEMENT

I have discussed the above points with the participant or, where appropriate, with the participant's legally authorized representative, using a translator when necessary. It is my opinion that the participant understands the risks, benefits, and procedures involved with participation in this research study.

(Signature of Researcher)

(Date)

FOOD INNOVATION CENTER EXPERIMENT STATION
COLLEGE OF AGRICULTURAL SCIENCES



OREGON STATE UNIVERSITY
1207 NW Naito Pkwy, Suite 154 • Portland, Oregon 97209-2834
Telephone: 503-872-6650 Fax: 503-872-6648

INFORMED CONSENT DOCUMENT

Project Title: Wine Quality Assessment Test

Principal Investigator: Anna B. Marin, Sensory Program Director, Food Innovation Center

Research Staff: Emily M. Jorgensen, Ann Colonna, Koei Kudo, Sun Lee

PURPOSE

This is a research study. The purpose of this research study is to evaluate wine consumers' quality assessment of white and red wine varieties. The results of this study will help the wine industry better understand the wine consumer's opinion of red and white wines. The purpose of this consent form is to give you the information you will need to help you decide whether to be in the study or not. Please read the form carefully. You may ask any questions about the research, what you will be asked to do, the possible risks and benefits, your rights as a volunteer, and anything else about the research or this form that is not clear. When all of your questions have been answered, you can decide if you want to be in this study or not. This process is called "informed consent". You will be given a copy of this form for your records.

We are inviting you to participate in this research study because you drink red and white wines. There are a total of 120 adults who are expected to participate in this study.

PROCEDURES

If you agree to participate, your involvement will last for approximately 20 minutes today and approximately 20 minutes next week. The following procedures are involved in both parts of this study. You will be given instructions on how to take the test either on a computer or on a paper ballot. You will be assigned to go a tasting booth where you will be served white and red wine samples each labeled with a random three-digit number. The wine used in this study is of the same quality that you would find in a grocery store or wine shop. You will be asked to rate how much you like each wine sample and reasons why.

RISKS

The risks involved in participating in this study are the same as consuming one glass of wine within an hour. You may drink the wine samples, or expectorate (spit out) them if you wish.

BENEFITS

There are no foreseeable personal benefits from participating in this study. The researchers anticipate that, in the future, society may benefit from this study by understanding consumer's opinion of red and white wines.

COSTS AND COMPENSATION

You will not have any costs for participating in this research project. You will be compensated for participating in this research project. At the end of the study, you will receive \$25 for completing all parts of the test. No compensation will be given unless both sessions of the test are completed.

CONFIDENTIALITY

Records of participation in this research project will be kept confidential to the extent permitted by law. However, federal government regulatory agencies and the Oregon State University Institutional Review Board (a committee that reviews and approves research studies involving human subjects) may inspect and copy records pertaining to this research. It is possible that these records could contain information that personally identifies you. Coded names and identification numbers will be used to ensure confidentiality. In the event of any report or publication from this study, your identity will not be disclosed. Results will be reported in a summarized manner in such a way that you cannot be identified.

VOLUNTARY PARTICIPATION

Taking part in this research study is voluntary. You may choose not to take part at all. If you agree to participate in this study, you may stop participating at any time. You are free to skip any questions that you would prefer not to answer. If you decide not to take part, or if you stop participating at any time, your decision will not result in any penalty or loss of benefits to which you may otherwise be entitled. If you withdraw from the study before it is completed, the results you provide may be included in the study.

QUESTIONS

Questions are encouraged. If you have any questions about this research project, please contact: Anna Marin, 503-872-6654 and anna.marin@oregonstate.edu and/or Emily Jorgensen, 503-872-6658 and emily.jorgensen@oregonstate.edu. If you have questions about your rights as a participant, please contact the Oregon State University

Institutional Review Board (IRB) Human Protections Administrator, at (541) 737-3437 or by e-mail at IRB@oregonstate.edu.

You may be contacted in the future to be part of other research studies. If you don't want to be contacted about future studies, just let one of the researchers know at any time.

Your signature indicates that this research study has been explained to you, that your questions have been answered, and that you agree to take part in this study. You will receive a copy of this form.

Participant's Name (printed):

(Signature of Participant)

(Date)

RESEARCHER STATEMENT

I have discussed the above points with the participant or, where appropriate, with the participant's legally authorized representative, using a translator when necessary. It is my opinion that the participant understands the risks, benefits, and procedures involved with participation in this research study.

(Signature of Researcher)

(Date)

WINE DIFFERENCE TEST

TEST NUMBER:

Panelist no: _____

Date: _____

1. Please taste the samples from left to right. You may drink the samples, or you may expectorate (spit out) the samples into the sink in the booth.

Two of the samples are the same; one is different. Select the **odd/different** sample by **CIRCLING** the sample code below. You must make a choice.

417

823

127

Please use the rinse solution to help cleanse your palate (mouth). You may drink the solution or expectorate (spit out) it into the sink in the booth. Please take a drink of water and eat the provided cracker.

2. Please taste the samples from left to right. You may drink the samples, or you may expectorate (spit out) the samples into the sink in the booth.

Two of the samples are the same; one is different. Select the **odd/different** sample by **CIRCLING** the sample code below. You must make a choice.

912

221

564

3. How frequently do you drink **RED** wine?

- _____ More than 3 Times a Week
- _____ Weekly
- _____ 2-3 times a Month
- _____ Once a Month
- _____ Less than Once a Month
- _____ Special Occasions
- _____ Never

4. Which of the following **RED** varieties do you **TYPICALLY** drink? (Mark all that apply.)

- _____ Merlot
- _____ Pinot Noir / Burgundy
- _____ Cabernet Sauvignon / Bordeaux
- _____ Zinfandel
- _____ Blends
- _____ Other
- _____ Unsure
- _____ I don't drink red wine.

5. What is the price range of the **RED** wine that you **TYPICALLY** buy?

- _____ \$5 and under
- _____ \$6-10

- ☐ \$11-15
- ☐ \$16-20
- ☐ \$21-30
- ☐ Over \$30
- ☐ I don't buy red wine.

6. How frequently do you drink **WHITE wine?**

- ☐ More than 3 Times a Week
- ☐ Weekly
- ☐ 2-3 times a Month
- ☐ Once a Month
- ☐ Less than Once a Month
- ☐ Special Occasions
- ☐ Never

7. Which of the following **WHITE varieties do you **TYPICALLY** drink? (Mark all that apply.)**

- ☐ Chardonnay
- ☐ Pinot Blanc
- ☐ Pinot Gris (Grigio)
- ☐ Riesling
- ☐ Gewurztraminer
- ☐ Blends
- ☐ Other
- ☐ Unsure
- ☐ I don't drink white wine.

8. What is the price range of the **WHITE wine that you **TYPICALLY** buy?**

- ☐ \$5 and under
- ☐ \$6-10
- ☐ \$11-15
- ☐ \$16-20
- ☐ \$21-30
- ☐ Over \$30
- ☐ I don't buy white wine.

9. Where do you **TYPICALLY buy your wine? Mark all that apply.**

- ☐ Grocery Store
- ☐ Wine Shop
- ☐ Club Store (CostCo, Sam's Club, etc.)
- ☐ Internet Shopping
- ☐ Restaurant
- ☐ Convenience Store
- ☐ Bar
- ☐ Other

THANK YOU! You are finished.

You may collect your incentive from the **Receptionist**.

WINE QUALITY ASSESSMENT TEST

Panelist no: _____

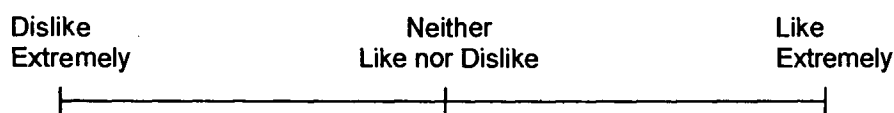
TEST NUMBER: _____

Date: _____

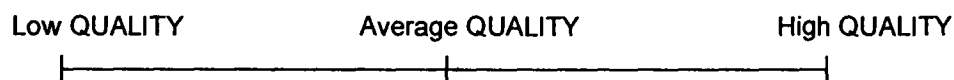
Instructions: After completing the questions for each sample please use the rinse solution to help cleanse your palate (mouth). Swirl the solution in your mouth then expectorate (spit out) it into the sink in the booth. Follow this with a water rinse and spit it out also. Then, please take a drink of water and eat the provided cracker.

1. Please taste sample # _____. You may drink the sample or expectorate (spit out) it into the sink in the booth.

Put an "X" on the line to indicate how much you LIKE the sample **OVERALL**.



2. Please rate the **QUALITY** of the sample by placing an "X" on the line.



3. Would you consider **BUYING** a wine like wine sample # ____? Please circle **only 1** ANSWER.

- 1- Would definitely NOT buy
- 2- Would probably NOT buy
- 3- Might not buy/Might buy
- 4- Would probably buy
- 5- Would definitely buy

4. Which of the following price categories would you expect pay for a wine like sample # _____?

- 1- Under \$6
- 2- \$6
- 3- \$8
- 4- \$10
- 5- \$12
- 6- \$14

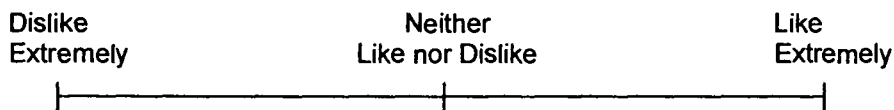
7- \$16

8- Over \$16

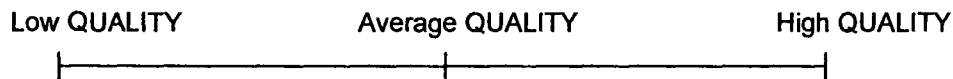
Please use the rinse solution to help cleanse your palate (mouth). Swirl the solution in your mouth and expectorate (spit out) it into the sink in the booth. Follow this with a water rinse also spitting the water out. Then, please take a drink of water and eat the provided cracker.

5. Please taste sample # _____. You may drink the sample or expectorate (spit out) it into the sink in the booth.

Put an "X" on the line to indicate how much you **LIKE** the sample **OVERALL**.



6. Please rate the **OVERALL QUALITY** of the sample by placing an "X" on the line.



7. Would you consider **BUYING** a wine like wine sample # _____? Please circle **only 1** ANSWER.

- 1- Would definitely NOT buy
- 2- Would probably NOT buy
- 3- Might not buy/Might buy
- 4- Would probably buy
- 5- Would definitely buy

8. Which of the following price categories would you expect pay for a wine like sample # _____?

- 1- Under \$6
- 2- \$6
- 3- \$8
- 4- \$10
- 5- \$12

6- \$14

7- \$16

8- Over \$16

9. How frequently do you drink **RED** wine? (Mark only **ONE**.)

- ☐ More than 3 Times a Week
- ☐ Weekly
- ☐ 2-3 times a Month
- ☐ Once a Month
- ☐ Less than Once a Month
- ☐ Special Occasions Only
- ☐ Never

10. Which of the following **RED** varieties do you TYPICALLY drink? (Mark **ALL** that apply.)

- ☐ Merlot
- ☐ Pinot Noir / Burgundy
- ☐ Cabernet Sauvignon / Bordeaux
- ☐ Zinfandel
- ☐ Blends
- ☐ Other
- ☐ Unsure
- ☐ I don't drink red wine.

11. What is the price range of the **RED** wine that you TYPICALLY buy?

- ☐ \$5 and UNDER
- ☐ \$6-10
- ☐ \$11-15
- ☐ \$16-20
- ☐ \$21-30
- ☐ Over \$30
- ☐ I don't buy red wine.

12. How frequently do you drink **WHITE** wine? (Mark only **ONE**.)

- ☐ More than 3 Times a Week
- ☐ Weekly
- ☐ 2-3 times a Month
- ☐ Once a Month
- ☐ Less than Once a Month
- ☐ Special Occasions Only
- ☐ Never

13. Which of the following **WHITE** varieties do you TYPICALLY drink? (Mark all that apply.)

- ☐ Sauvignon Blanc
- ☐ Pinot Blanc
- ☐ Pinot Gris (Grigio)
- ☐ Riesling
- ☐ Gewurztraminer
- ☐ Chardonnay

- ☐ Blends
- ☐ Other
- ☐ Unsure
- ☐ I don't drink white wine.

14. What is the price range of the **WHITE wine that you **TYPICALLY** buy?**

- ☐ \$5 and UNDER
- ☐ \$6-10
- ☐ \$11-15
- ☐ \$16-20
- ☐ \$21-30
- ☐ Over \$30
- ☐ I don't buy white wine.

15. Where do you **TYPICALLY buy your wine? Mark all that apply.**

- ☐ Grocery Store
- ☐ Wine Shop
- ☐ Winery
- ☐ Club Store (Ex. Costco)
- ☐ Internet Shopping
- ☐ Restaurant
- ☐ Convenience Store
- ☐ Bar
- ☐ Other

16. Please indicate your gender

- ☐ Male
- ☐ Female

17. Please indicate your age range.

- ☐ 21-24
- ☐ 25-35
- ☐ 36-45
- ☐ 46-55
- ☐ 56- 65
- ☐ 66+

THANK YOU! You are finished.
You may collect your incentive from the **Receptionist**.

WINE QUALITY ASSESSMENT TEST

Panelist no: _____

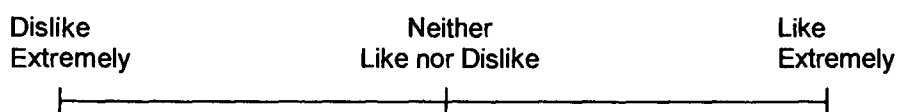
Date: _____

Instructions: After completing the questions for each sample please use the rinse solution to help cleanse your palate (mouth). Swirl the solution in your mouth then expectorate (spit out) it into the sink in the booth. Follow this with a water rinse and spit it out also. Then, please take a drink of water and eat the provided cracker.

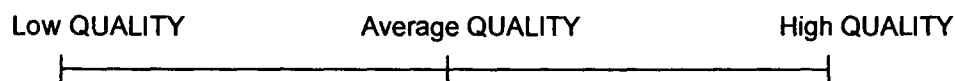
Please consider the information in the photographs about the wine sample when answering each of the following questions regarding that sample.

1. Please taste sample # _____. You may drink the sample or expectorate (spit out) it into the sink in the booth.

Put an "X" on the line to indicate how much you LIKE the sample **OVERALL**.



2. Please rate the **QUALITY** of the sample by placing an "X" on the line.



3. Would you consider **BUYING** a wine like wine sample # _____? Please circle **only 1** ANSWER.

6- Would DEFINITELY NOT BUY

7- Would PROBABLY NOT BUY

8- MIGHT NOT BUY/MIGHT BUY

9- Would PROBABLY BUY

10- Would DEFINITELY BUY

4. Which of the following price categories would you expect pay for a wine like sample # _____?

9- Under \$6

10- \$6

11- \$8

12- \$10

13- \$12

14- \$14

15- \$16

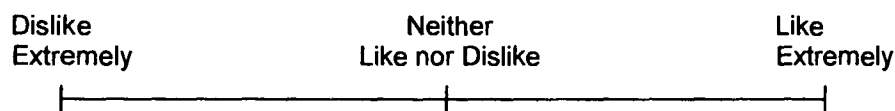
16- Over \$16

Please use the rinse solution to help cleanse your palate (mouth). Swirl the solution in your mouth and expectorate (spit out) it into the sink in the booth. Follow this with a water rinse also spitting the water out. Then, please take a drink of water and eat the provided cracker.

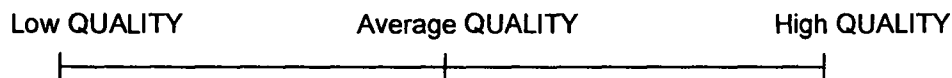
Please consider the information in the photographs about the wine sample when answering each of the following questions regarding that sample.

5. Please taste sample # _____. You may drink the sample or expectorate (spit out) it into the sink in the booth.

Put an "X" on the line to indicate how much you LIKE the sample **OVERALL**.



6. Please rate the QUALITY of the sample by placing an "X" on the line.



7. Would you consider BUYING a wine like wine sample # _____? Please circle **only 1 ANSWER.**

1- Would DEFINITELY NOT BUY

2- Would PROBABLY NOT BUY

3- MIGHT NOT BUY/MIGHT BUY

4- Would PROBABLY BUY

5- Would DEFINITELY BUY

8. Which of the following price categories would you expect pay for a wine like sample # _____?

1- Under \$6

2- \$6

3- \$8

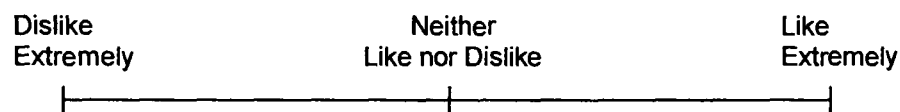
- 4- \$10
- 5- \$12
- 6- \$14
- 7- \$16
- 8- Over \$16

Please use the rinse solution to help cleanse your palate (mouth). Swirl the solution in your mouth and expectorate (spit out) it into the sink in the booth. Follow this with a water rinse also spitting the water out. Then, please take a drink of water and eat the provided cracker.

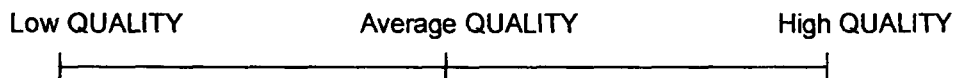
Please consider the information in the photographs about the wine sample when answering each of the following questions regarding that sample.

9. Please taste sample # _____. You may drink the sample or expectorate (spit out) it into the sink in the booth.

Put an "X" on the line to indicate how much you LIKE the sample OVERALL.



10. Please rate the QUALITY of the sample by placing an "X" on the line.



11. Would you consider BUYING a wine like wine sample # ____? Please circle only 1 ANSWER.

- 1- Would DEFINITELY NOT BUY
- 2- Would PROBABLY NOT BUY
- 3- MIGHT NOT BUY/MIGHT BUY
- 4- Would PROBABLY BUY
- 5- Would DEFINITELY BUY

12. Which of the following price categories would you expect pay for a wine like sample # ____?

- 1- Under \$6
- 2- \$6

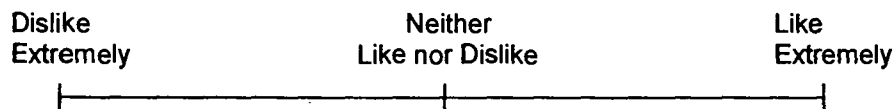
- 3- \$8
- 4- \$10
- 5- \$12
- 6- \$14
- 7- \$16
- 8- Over \$16

Please use the rinse solution to help cleanse your palate (mouth). Swirl the solution in your mouth and expectorate (spit out) it into the sink in the booth. Follow this with a water rinse also spitting the water out. Then, please take a drink of water and eat the provided cracker.

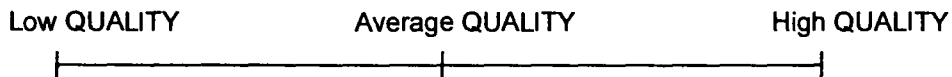
Please consider the information in the photographs about the wine sample when answering each of the following questions regarding that sample.

13. Please taste sample # _____. You may drink the sample or expectorate (spit out) it into the sink in the booth.

Put an "X" on the line to indicate how much you LIKE the sample **OVERALL**.



14. Please rate the QUALITY of the sample by placing an "X" on the line.



15. Would you consider BUYING a wine like wine sample # ____? Please circle only 1 ANSWER.

- 6- Would DEFINITELY NOT BUY
- 7- Would PROBABLY NOT BUY
- 8- MIGHT NOT BUY/MIGHT BUY
- 9- Would PROBABLY BUY
- 10- Would DEFINITELY BUY

16. Which of the following price categories would you expect pay for a wine like sample # ____?

- 1- Under \$6

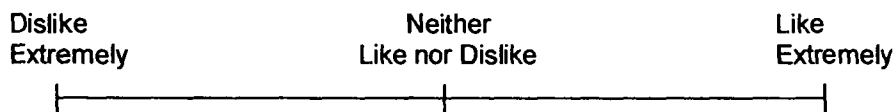
- 2- \$6
- 3- \$8
- 4- \$10
- 5- \$12
- 6- \$14
- 7- \$16
- 8- Over \$16

Please use the rinse solution to help cleanse your palate (mouth). Swirl the solution in your mouth and expectorate (spit out) it into the sink in the booth. Follow this with a water rinse also spitting the water out. Then, please take a drink of water and eat the provided cracker.

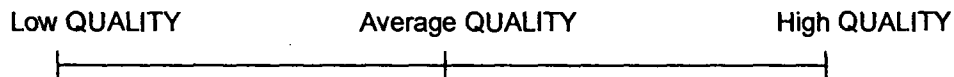
Please consider the information in the photographs about the wine sample when answering each of the following questions regarding that sample.

17. Please taste sample # _____. You may drink the sample or expectorate (spit out) it into the sink in the booth.

Put an "X" on the line to indicate how much you LIKE the sample **OVERALL**.



18. Please rate the QUALITY of the sample by placing an "X" on the line.



19. Would you consider BUYING a wine like wine sample # ____? Please circle only 1 ANSWER.

- 1- Would DEFINITELY NOT BUY
- 2- Would PROBABLY NOT BUY
- 3- MIGHT NOT BUY/MIGHT BUY
- 4- Would PROBABLY BUY
- 5- Would DEFINITELY BUY

20. Which of the following price categories would you expect pay for a wine like sample # _____?

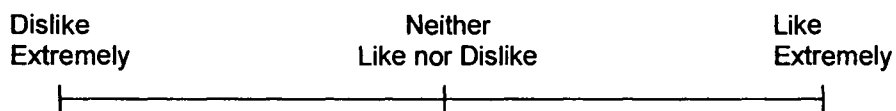
- 1- Under \$6
- 2- \$6
- 3- \$8
- 4- \$10
- 5- \$12
- 6- \$14
- 7- \$16
- 8- Over \$16

Please use the rinse solution to help cleanse your palate (mouth). Swirl the solution in your mouth and expectorate (spit out) it into the sink in the booth. Follow this with a water rinse also spitting the water out. Then, please take a drink of water and eat the provided cracker.

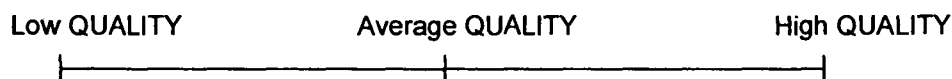
Please consider the information in the photographs about the wine sample when answering each of the following questions regarding that sample.

21. Please taste sample # _____. You may drink the sample or expectorate (spit out) it into the sink in the booth.

Put an "X" on the line to indicate how much you LIKE the sample **OVERALL**.



22. Please rate the **QUALITY** of the sample by placing an "X" on the line.



23. Would you consider **BUYING** a wine like wine sample # _____? Please circle **only 1 ANSWER**.

- 1- Would DEFINITELY NOT BUY
- 2- Would PROBABLY NOT BUY
- 3- MIGHT NOT BUY/MIGHT BUY
- 4- Would PROBABLY BUY

5- Would DEFINITELY BUY

24. Which of the following price categories would you expect pay for a wine like sample #_____?

- 1- Under \$6
- 2- \$6
- 3- \$8
- 4- \$10
- 5- \$12
- 6- \$14
- 7- \$16
- 8- Over \$16

Please use the rinse solution to help cleanse your palate (mouth). Swirl the solution in your mouth and expectorate (spit out) it into the sink in the booth. Follow this with a water rinse also spitting the water out. Then, please take a drink of water and eat the provided cracker.

25. Circle **ALL** of the following statements that you believe to be true:

- a) Natural corks are used in wine because of its tradition.
- b) Synthetic/plastic corks are used in wines because they're cheaper than natural corks.
- c) Screw caps are used in wines because they're cheaper than natural corks.
- d) Natural corks indicate high wine quality.
- e) Synthetic/plastic corks indicate high wine quality.
- f) Screw caps indicate high wine quality.
- g) Natural corks can sometimes cause wines to smell and taste bad.
- h) Synthetic/plastic corks can sometimes cause wines to smell and taste bad.
- i) Screw caps can sometimes cause wines to smell and taste bad.
- j) Synthetic/plastic corks prevent spoilage that has been associated with natural corks.
- k) Screw caps prevent spoilage that has been associated with natural corks.
- l) Synthetic/plastic corks are acceptable substitutes for natural corks.
- m) Screw caps are acceptable substitutes for natural corks.
- n) Natural corks preserve wines better than synthetic/plastic corks.

- o) Natural corks preserve wines better than screw caps
- p) Synthetic/plastic corks preserve wines better than natural corks.
- q) Synthetic/plastic corks preserve wines better than screw caps.
- r) Screw caps preserve wines better than natural corks.
- s) Screw caps preserve wines better than synthetic/plastic corks.

26. I would buy a wine with a synthetic/plastic cork.

- 1- Strongly Disagree
- 2- Disagree
- 3- Slightly Disagree
- 4- Neither Disagree Nor Agree
- 5- Slightly Agree
- 6- Agree
- 7- Strongly Agree

27. I would buy a wine with a screw cap.

- 1- Strongly Disagree
- 2- Disagree
- 3- Slightly Disagree
- 4- Neither Disagree Nor Agree
- 5- Slightly Agree
- 6- Agree
- 7- Strongly Agree

28. I believe that wines with synthetic/plastic corks are **HIGHER in quality than wines with natural corks.**

- 1- Strongly Disagree
- 2- Disagree
- 3- Slightly Disagree
- 4- Neither Disagree Nor Agree
- 5- Slightly Agree
- 6- Agree
- 7- Strongly Agree

29. I believe that wines with screw caps are **HIGHER in quality than wines with natural corks.**

- 1- Strongly Disagree
- 2- Disagree

- 3- Slightly Disagree
- 4- Neither Disagree Nor Agree
- 5- Slightly Agree
- 6- Agree
- 7- Strongly Agree

30. I would be disappointed if I bought a wine at a restaurant and it came out with a synthetic cork.

- 1- Strongly Disagree
- 2- Disagree
- 3- Slightly Disagree
- 4- Neither Disagree Nor Agree
- 5- Slightly Agree
- 6- Agree
- 7- Strongly Agree

31. I would be disappointed if I bought a wine at a restaurant and it came out with a screw cap.

- 1- Strongly Disagree
- 2- Disagree
- 3- Slightly Disagree
- 4- Neither Disagree Nor Agree
- 5- Slightly Agree
- 6- Agree
- 7- Strongly Agree

32. In a restaurant I would send back a wine that came out with a synthetic/plastic cork.

- 1- Strongly Disagree
- 2- Disagree
- 3- Slightly Disagree
- 4- Neither Disagree Nor Agree
- 5- Slightly Agree
- 6- Agree
- 7- Strongly Agree

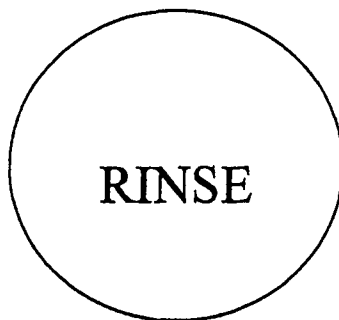
33. In a restaurant I would send back a wine that came out with a screw cap.

- 1- Strongly Disagree
- 2- Disagree
- 3- Slightly Disagree
- 4- Neither Disagree Nor Agree
- 5- Slightly Agree
- 6- Agree
- 7- Strongly Agree

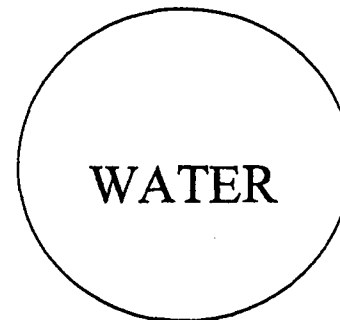
THANK YOU! You are finished.
You may collect your incentive from the **Receptionist**.

8 Consumer # _____

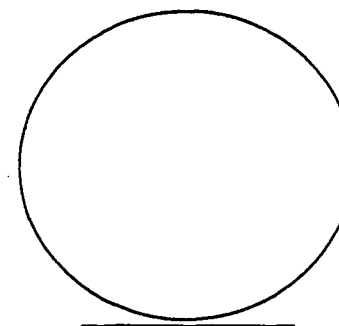
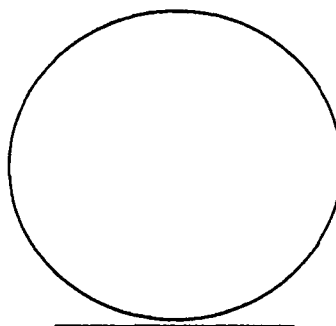
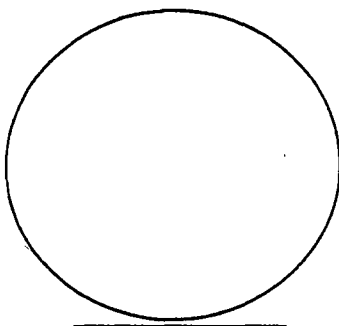
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RINSE



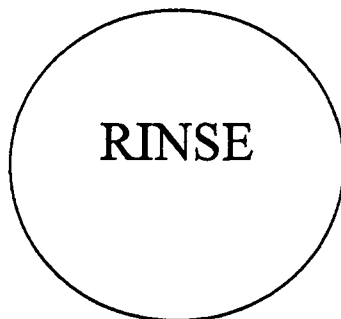
WATER



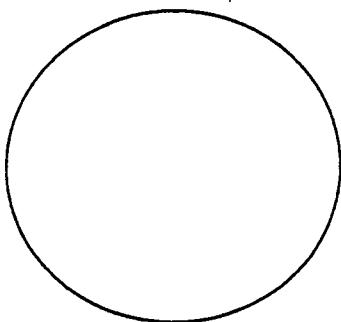
Which white wine sample is different?

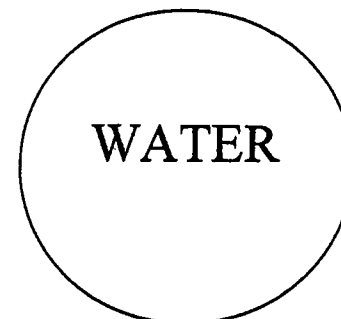
84 Consumer # _____

Date: 2-25-04

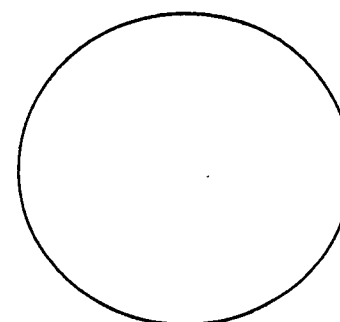


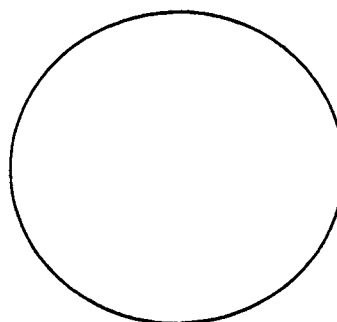
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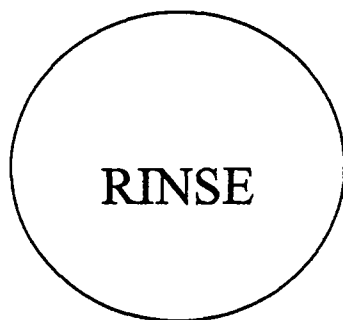
WATER



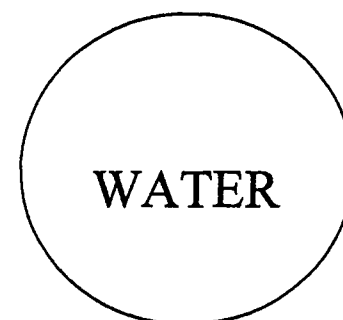


Which red wine sample is different?

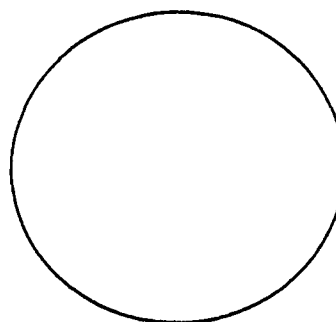
Consumer # _____

Date: 3-12-04

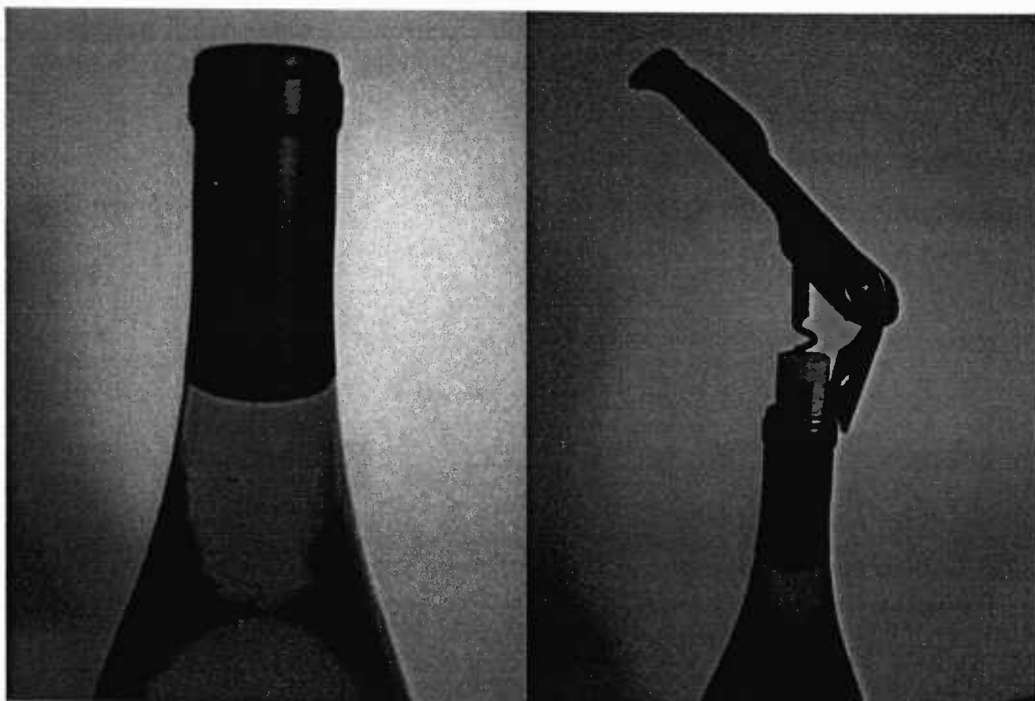
RINSE



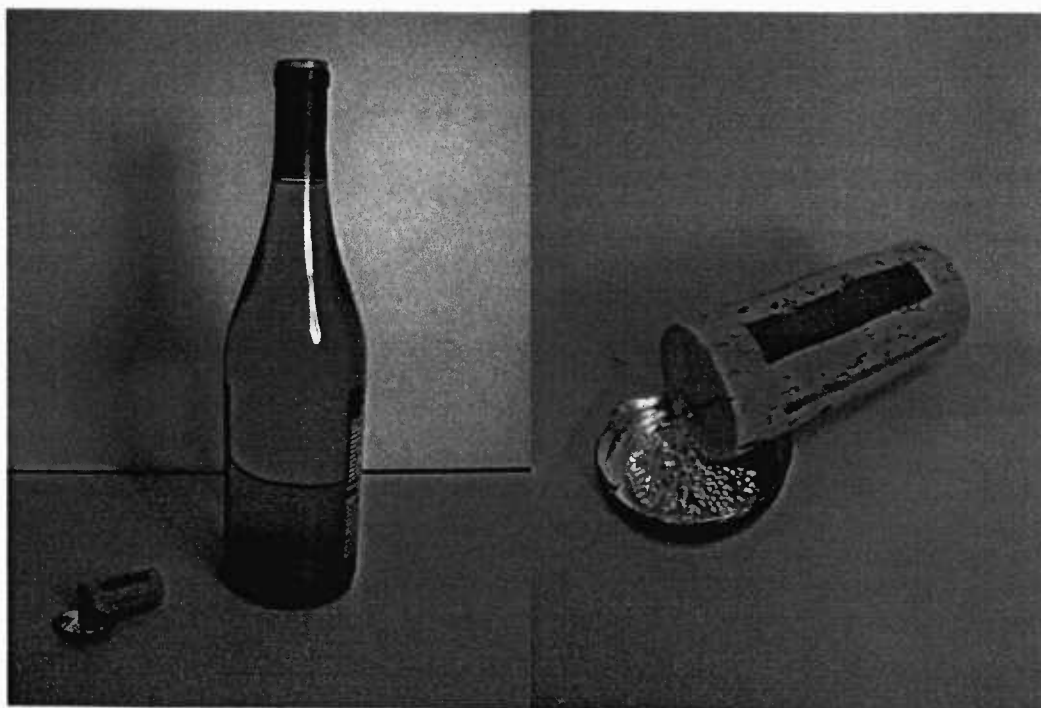
WATER

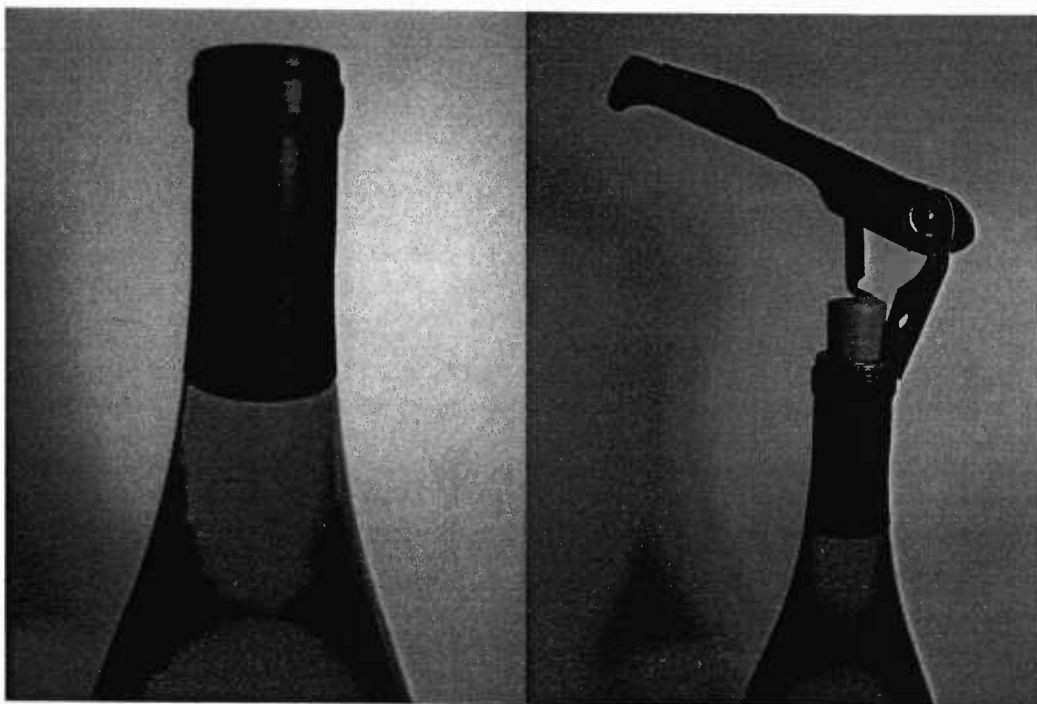


wine sample

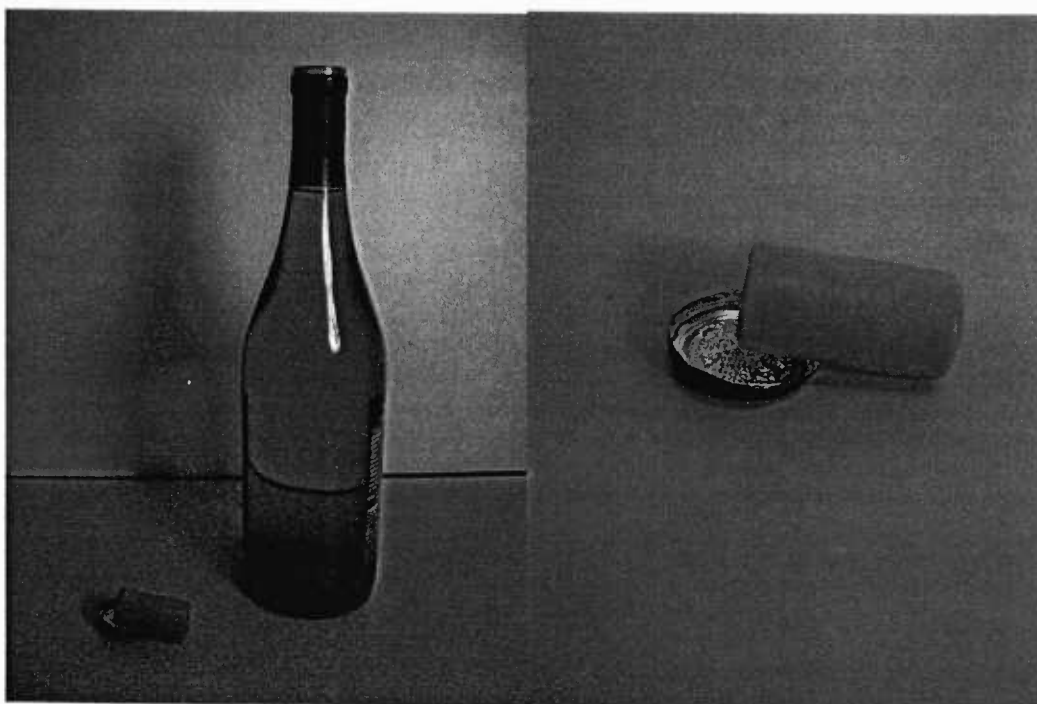


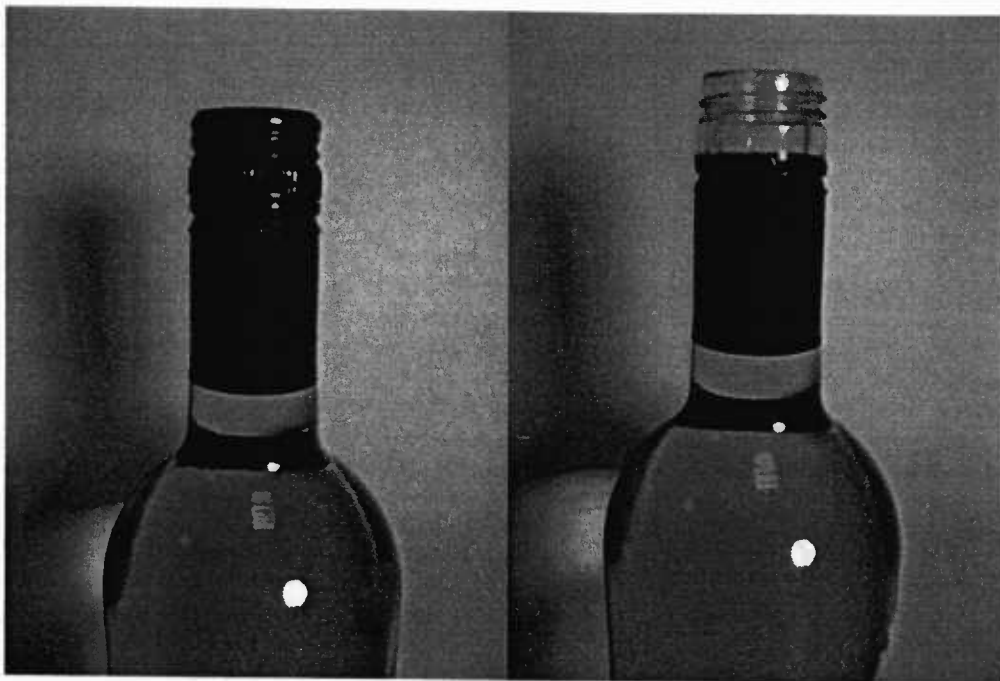
Natural Cork - 446



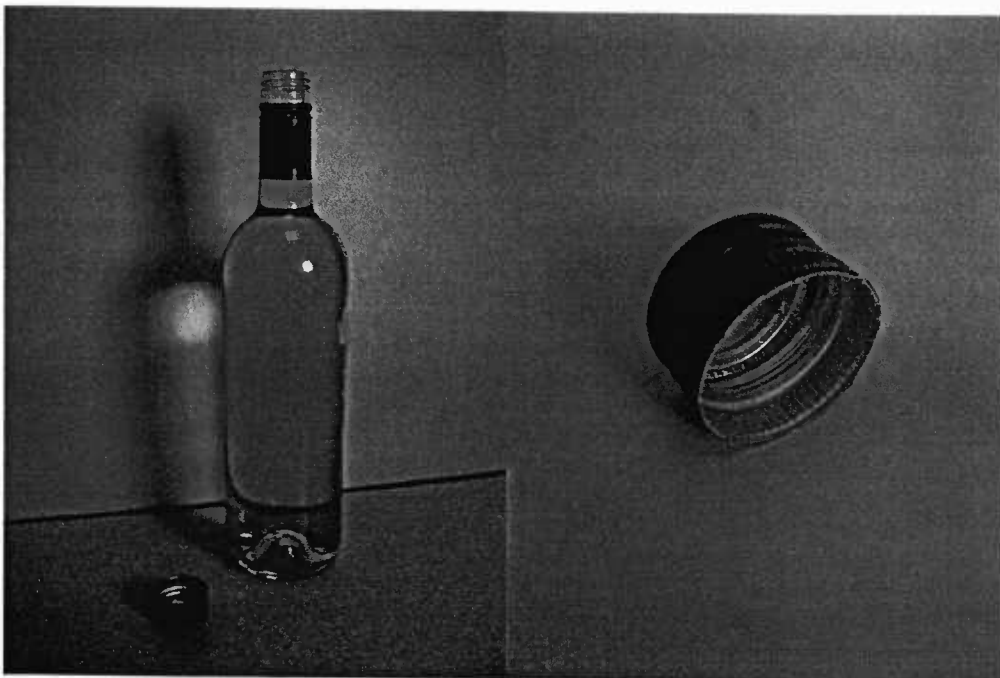


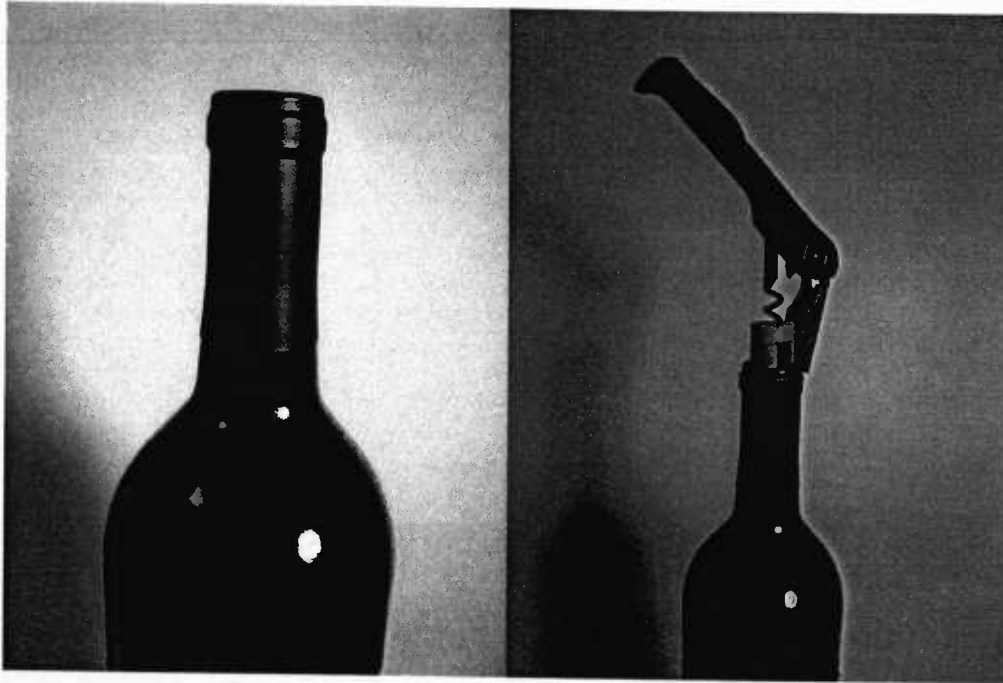
Synthetic Cork - 218



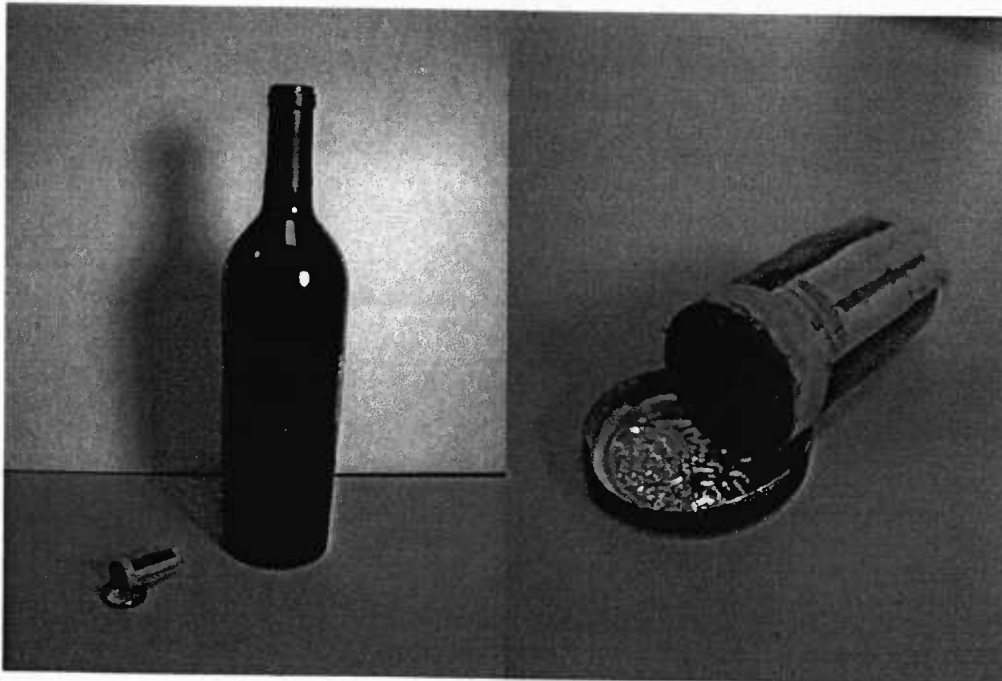


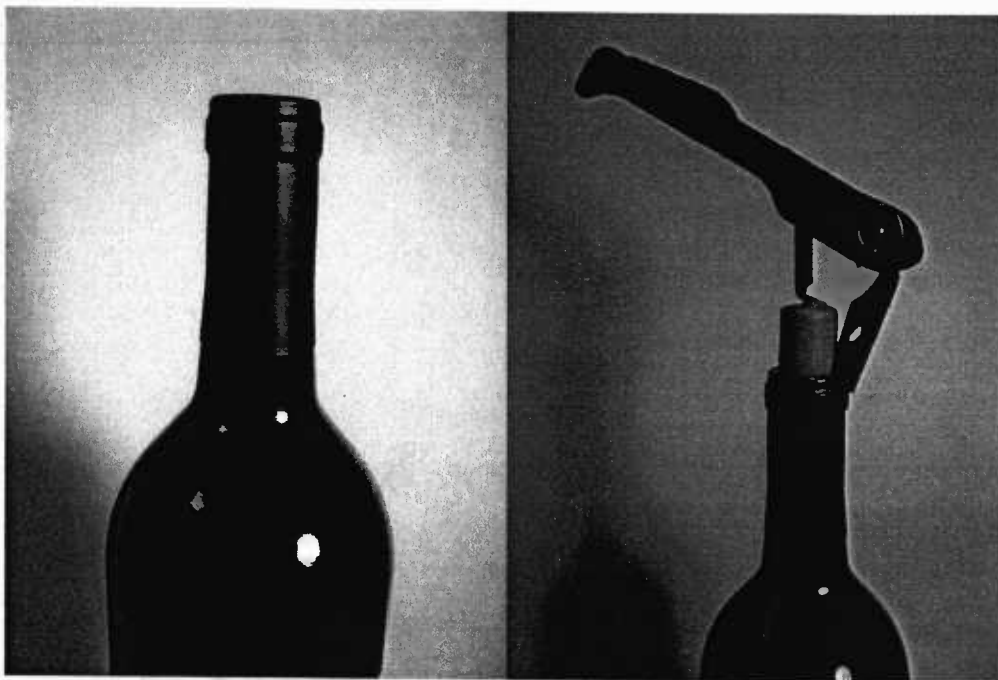
Screw Cap - 755



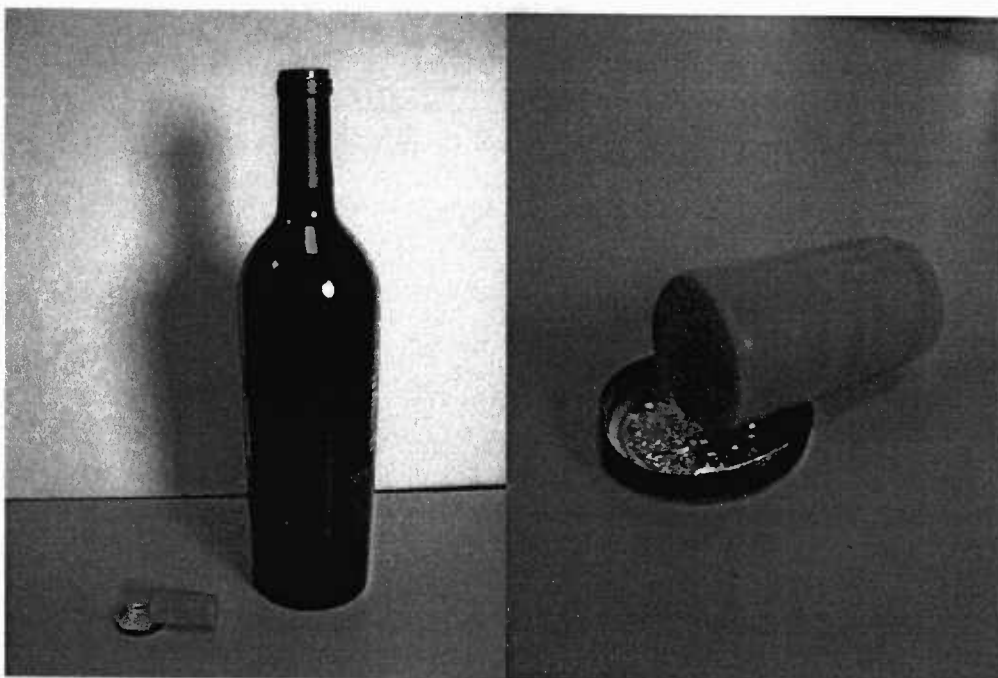


Natural Cork - 113



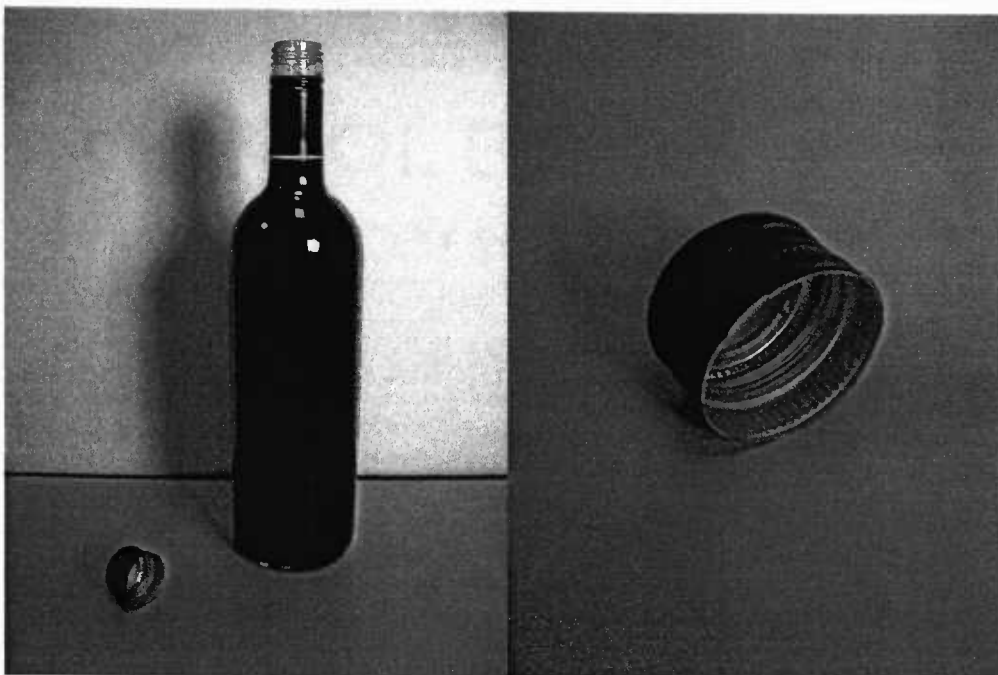


Synthetic Cork - 689





Screw Cap - 974



Check all that you believe to be true (using the computer):

- a) Natural corks are used in wine because of its tradition.
- b) Synthetic/plastic corks are used in wines because they're cheaper than natural corks.
- c) Screw caps are used in wines because they're cheaper than natural corks.
- d) Natural corks indicate high wine quality.
- e) Synthetic/plastic corks indicate high wine quality.
- f) Screw caps indicate high wine quality.
- g) Natural corks can sometimes cause wines to smell and taste bad.
- h) Synthetic/plastic corks can sometimes cause wines to smell and taste bad.
- i) Screw caps can sometimes cause wines to smell and taste bad.
- j) Synthetic/plastic corks prevent spoilage that has been associated with natural corks.
- k) Screw caps prevent spoilage that has been associated with natural corks.
- l) Synthetic/plastic corks are acceptable substitutes for natural corks.
- m) Screw caps are acceptable substitutes for natural corks.
- n) Natural corks preserve wines better than synthetic/plastic corks.
- o) Natural corks preserve wines better than screw caps.
- p) Synthetic/plastic corks preserve wines better than natural corks.
- q) Synthetic/plastic corks preserve wines better than screw caps.
- r) Screw caps preserve wines better than natural corks.
- s) Screw caps preserve wines better than synthetic/plastic corks.