Increasing Direct Marketing for Fruit Farmers by Connecting Producer to Producer through Research and Development of a Value-Added Product

Final Report
Federal –State Marketing Improvement Program

Grant Agreement No. 12-25-G-0341

Submitted to Jim Anderson, Program Director
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INTRODUCTION

Missouri fruit growers rely on the fresh market to sell their product. Currently growers are struggling to remain competitive in that market. If the fresh market is oversupplied, most growers have no alternative market for the surplus. Some growers lose 30 percent of their crop due to surplus and damage. As a result, a significant portion of the harvested crop is lost with no economic benefit to the grower.

The purpose of this proposal was to connect fruit growers who have surplus fruit with wineries interested in developing a new value-added product, fruit brandy. The proposed study was a continuation of the research project under the same name funded by USDA in 2000-2001. This proposal focused on assisting and educating the growers and wineries interested in adopting a market connection between fruit producer and brandy producer as a result of the findings from the first year of research. This was a crucial step in solidifying the effort of the first year to successfully complete the connection between the fruit and wine industries. Researchers made adjustments in methods based on the outcome of the evaluation of the first year's products, and continue perfecting the new products developed. The benefits of this project are that the state fruit growers will increase their sustainability by having an alternative market for their crops (damaged or undamaged), and the grape and wine industry will add new products to their product mix. The state of Missouri will benefit from increased revenues received from the value-added products produced within the state.

Goal 1: The State of Missouri will have implemented a program that connects producer to producer by connecting fruit growers with surplus fruit to wineries interested in making fruit brandy.

Objective 1: Educate the fruit and wine industries about how to start up and operate a distillery for the commercial production of fruit brandy products.

Activities completed:

(a.) Give presentations that help growers and vintners learn first hand about what is involved in the operations of a distillery.

1) Growers and vintners visit the distillery on a regular basis for demonstrations and discussions about the process of distillery operation.

(b.) Continue to advise growers and vintners through the process of making producer-to-producer market connections.

1) One Missouri winery has established a distillery, and through advisement has contracted with growers here in the state to purchase surplus fruit for the purpose of making brandy on a commercial scale. Other Missouri wineries are negotiating the purchase of distilleries and continually call the State Fruit Experiment Station for advisement services.

Goal 2: The State of Missouri will have developed a new value-added product, fruit brandy, using surplus fruit from Missouri fruit farmers.

Objective 1: Assess successful distillery operations at the research and commercial level, and apply the information gained to this project.

Activities completed:

(a.) Visit distilleries in other states and countries to talk with experts about specific techniques necessary for the production and evaluation of quality brandy products.

1) Attendance to the 17th Annual Midwest Grape and Wine conference symposium on fortification and port production allowed discussions with Tim Spence, expert in fortification for 30 plus years. The techniques discussed and information attained will be assessed so that the knowledge gained can be applied to the fruit port production research.

2) Lee Lutes, owner of Black Star Farms, visited the Station to evaluate 2001 Station brandies and train Kimberly Rey, SMSU Distiller, in fruit-in-the-bottle technique for specialty brandies.
3) Alexander Plank, German Distillation Engineer and owner of German Distillation Company: Christian Carl Distillery Technology, visited the Station to evaluate 2001 and 2002 Station brandies as well as continue the education and training of Kimberly Rey, SMSU Distiller.
4) Volker Dietrich, German Distillation Engineer and owner of the German Distillation Company: Arnold Holstein, visited the Station to evaluate 2001 and 2002 Station brandies and continue the education and training of Kimberly Rey, SMSU Distiller.

Objective 2: Produce fruit brandy, which can then be used to make other fruit products such as fruit ports and fruit infusions.

Activities completed:

(a.) Purchase test equipment required to produce and evaluate fruit brandy.

(b.) Make adjustments in methods based on researcher and industry recommendations from year one.

A complete report is submitted by Kimberly Rey in ATTACHMENT A

Objective 3: Publish a technical report, and mail to the fruit growers and vintners of Missouri.

Activity completed

ATTACHMENT A

Goal 2 Final Report

INTRODUCTION

The purpose of this portion of the project was to continue to improve the method used to produce quality distillates of fruit brandy, and determine which varieties of fruit showed the most promise as a fruit brandy. Two types of distillates were studied, distillates that produce high quality sipping brandies and tail-cut distillates that were redistilled.

METHODS AND MATERIALS

Fruits grown at the State Fruit Experiment station were used for this project. Each variety of fruit was mashed and fermented to dryness. No microbial antiseptics such as sulfur dioxide were added to the mash throughout or following fermentation. Lalvin V1116 yeast, diammonium phosphate and Fermaid nutrients, and hemicellulose enzymes were added to aid fermentation. Analysis for percent titratable acidity, pH, and sugar content as ºBrix was conducted pre-fermentation, and percent ethanol content was conducted post-fermentation. Only one variety of peaches, Red Haven, was available for fermentation this season. Four varieties of apples, Jonathon, Gayla, Red Delicious, and Ozark Gold were fermented as varietal batches. Three batches of mixed apples were fermented. Since fruit quality has an effect on the fermentation, which in-turn affects the distillates produced, fruit quality was documented [1]. The fruit quality determination was based on the presence of bruises, molds, fungi, and the extent of insect damage in pits or cores.

A 3-plate 120 L column still was used for all distillations. A schematic diagram of a 120 L Christian-Carl still is shown in Figure 1. The operation of a steam jacket still is as follows.

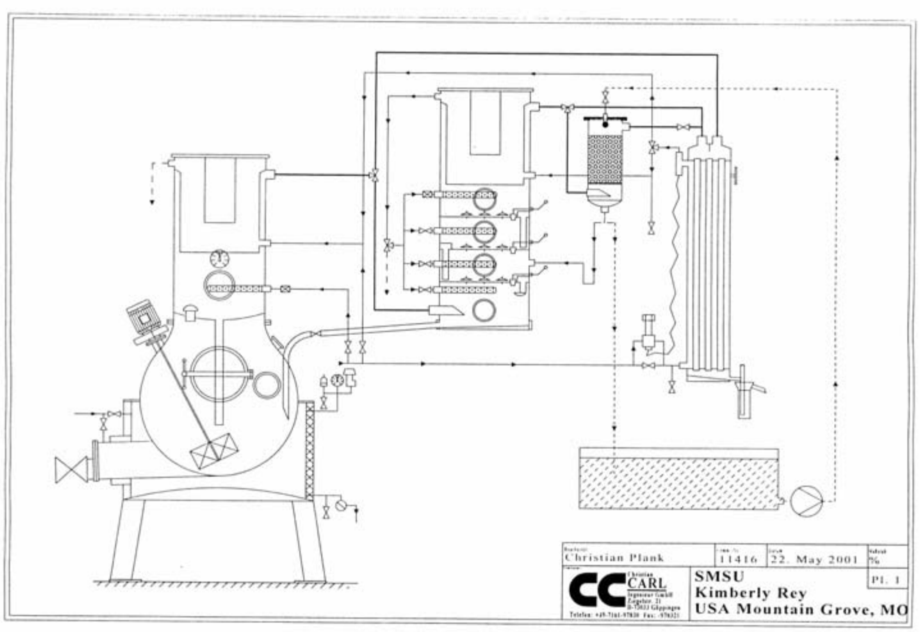


Figure 1. Schematic diagram of a Christian-Carl 120 L still [2].

The still is operated by a steam jacket, which heats the mash to boiling under normal pressure conditions. Cooling water is passed through the total condenser and into the column-dephlegmater (partial condenser). The cooling water is kept at 23 ºC at the top of the condenser and the flow of water into the column-dephlegmator is regulated. The purpose of the column-dephlegmator is to partially condense the distillate vapor, returning a portion of it as countercurrent distillate to be re-distilled. The three plates in the column are copper sieves, which the distillate vapors can pass through as they rise through the column. The countercurrent distillate drains back down and sits on the next lower plate to be re-distilled therefore increasing the efficiency of separation of different components. This process is called reflux and rectification [1, 2, 3]. The water in the column-dephlegmator will remain at 23 ºC until the distillate vapor of the mash increases the temperature of the water. Alcohols with low boiling points vaporize at lower temperatures, and are referred to as the head cut of the distillate. As the temperature of the mash increases alcohols with higher boiling points begin to vaporize and are referred to as the heart cut of the distillate. Alcohols that boil at temperatures higher than approximately 88 ºC are considered the tail cut of the distillate [2]. Table 1 shows the boiling points of the components commonly found in fruit distillate [3, 4]. The increase in the temperature of the vapor raises the temperature of the dephlegmator as the vapors come in contact with it. As the distillate vapors rise up through the column the vapors eventually move out of the top column and into the total condenser. The distillate vapor is then condensed and is collected as a liquid from the bottom of the total condenser [1, 2].

Components of distillates	***Boiling Points ºC at 760 mmHg***
Acetaldehyde	21
Acetone	56.5
Ethyl formate	53-54
Ethyl acetate	77
Methanol	64.7
Ethanol	78.5
n-propanol	97.2
isopentyl alcohol (isoamyl alcohol)	130.5
Benzaldehyde	179

Table 1**.** Components most commonly found in fruit distillates and their boiling points at normal pressure [4].

The distillation for this project involved 120 L of mash pumped into the pot of the still. Cooling water was circulated through the column-dephlegmator and the total condenser. Pressure on the steam jacket was determined by the mash being distilled. Most mashes required the pressure within the jacket to be kept at 0.5 bar until reflux began on the third plate. Once reflux began on the third plate the pressure was reduced to between 0.2 and 0.3 bar for the remainder of product collection. Re-distillation of tails required pressure less than 0.05 bar.

The product was collected in three stages, head, heart, and tail using sensory analysis to determine the cuts. The distillate was collected as cuts of 500-1000 ml of head followed by collection of the heart until a noticeable change in aroma from fruity to musty or rancid was detected. At the change in aroma the tail cut was collected until 15% alcohol was remained in the product. The tail was stored until it could be redistilled. The cuts were made based on sensory evaluation for the presence and then absence of acetaldehyde and ethyl acetate for the head cut, and the musty or rancid, off odors of higher alcohols for the tail cut.

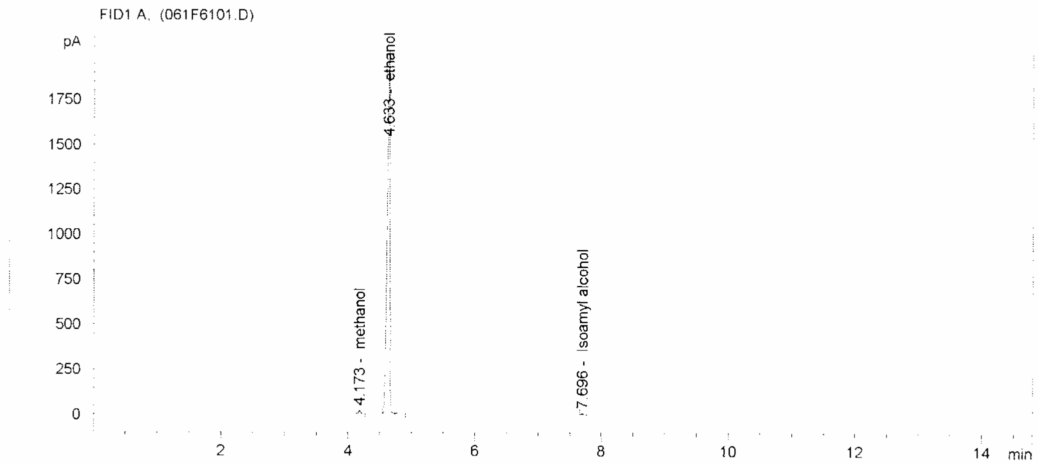
The distillates were evaluated by sensory analysis. This involved reduction of the spirits to a drinkable grade of 40% using distilled water. Distilled water was used so that the water had no influence on the aroma and flavor of the distillate [1]. Sensory evaluation was then performed using aroma and flavor. This procedure was conducted at the time the distillates were collected and after a six-week aging period. The spirits were also evaluated by analytical separation of the components using a Hewlett Packard 6890 Gas Chromatography (GC) instrument with auto-sample injector and a Flame Ionization Detector (FID). This was done to verify the cuts of head, heart, and tail made using sensory during the distillation process. Eighty-five samples were collected from the distillation of five varieties of fruit and five batches of mixed fruit. The average value for each triplicate run was used to plot the trend of head, heart, and tail cut composition in relation to the sensory cut made at the time of distillation. A 30m Alltech EC-WAX (polyethylene glycol) capillary column with an inner diameter of 0.25 mm was used for all measurements. The initial conditions for the chromatographic analysis were: column temperature at 40 ºC, injector port temperature of 240 ºC, and the detector temperature at 255 ºC. The temperature program used for the analysis was initially 40 ºC and ramped at 25 ºC/min until a temperature of 210 ºC was reached. The temperature was held at 210 ºC for 5 minutes. An injection of 0.5 µL was used with a split ratio on the column of 50:1. Each sample took 14.80 minutes to run. The samples were evaluated for their content of acetone, ethyl acetate, methanol, ethanol, n-propanol, and isopentyl alcohol (isoamyl alcohol).

RESULTS

The separation of the head cut from the heart cut for all the varieties of peaches and apples was easily made by sensory as well as GC analysis. The disappearance of the aroma of ethyl acetate signified the cut at the time the distillates were collected. This also proved to be true using GC analysis by the disappearance of these compounds from the GC chromatogram. Ethyl acetate was present on the GC chromatogram in the head cut, but was undetectable by GC or sensory analysis in the heart or tail cut. Figure 2 shows an example of the full report for one injection of a sample. The report includes the chromatogram and all data relating to the sample. For simplicity purposes, only the chromatograms are used in Figures 3 and 4. The absence of ethyl acetate in the heart and tail cuts is shown in Figures 3 and 4. These cuts were made using sensory evaluation at the time the sample was collected.

Data File C:\HPCHEM\1\DATA\061F6101.D Sample Name: OGA 10-2 tl B2

Injection Date : 12/22/02 5:31:40 AM Seq. Line : 61
Sample Name : OGA 10-2 tl B2 Vial : 61
Acq. Operator : Kimberly Rey Inj : 1
Inj Volume : 1 ul
Sequence File : C:\HPCHEM\1\SEQUENCE\SPIRIT02.S
Acq. Method : C:\HPCHEM\1\METHODS\DISTILL.M
Last changed : 12/17/02 9:47:48 AM by Kimberly Rey
Analysis Method : C:\HPCHEM\1\METHODS\DISTILL.M
Last changed : 12/23/02 8:06:36 AM by Kimberly Rey



External Standard Report

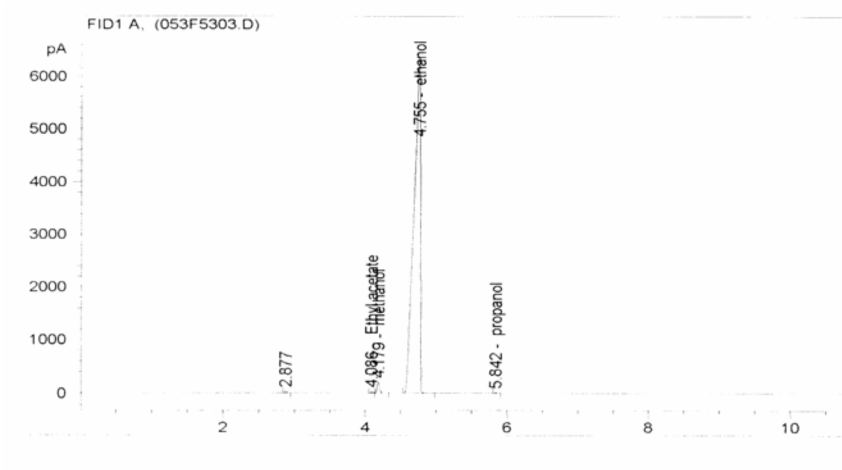
Sorted By : Signal
Calib. Data Modified : Tuesday, December 17, 2002 2:31:34 PM
Multiplier : 1.0000
Dilution : 1.0000

Signal 1: FID1 A,

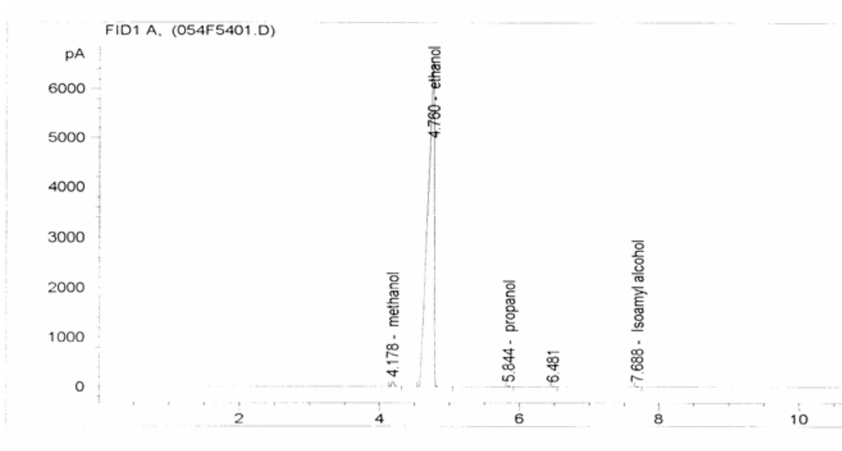
RetTime [min]	Type	Area [pA*s]	Amt/Area	Amount [%]	Grp	Name
3.462		-	-	-		acetone
4.065		-	-	-		Ethyl acetate
4.173	BB	40.42293	2.42462e-3	9.80102e-2		methanol
4.633	BB	5887.94824	3.93368e-3	23.16128		ethanol
5.835		-	-	-		propanol
7.696	BB	10.90154	1.47417e-2	1.60707e-1		Isoamyl alcohol

Totals : 23.42000

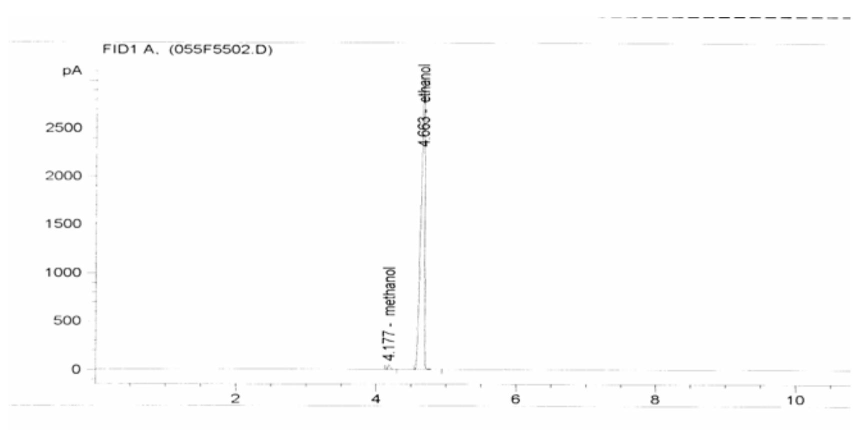
Figure 2. Example of data report from GC analysis.



a. Peaks for the head cut.

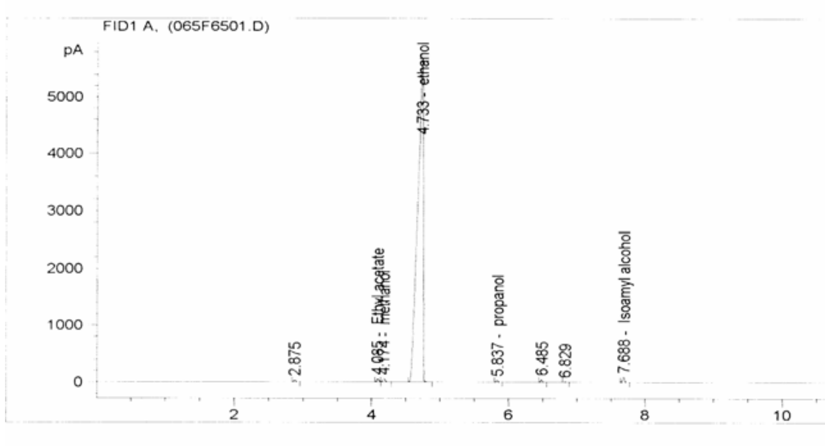


b. Peaks for the heart cut.

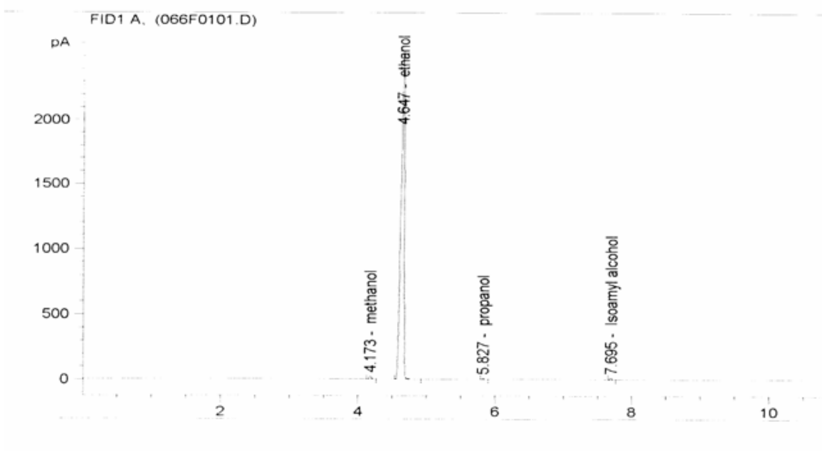


c. Peaks for the tail cut.

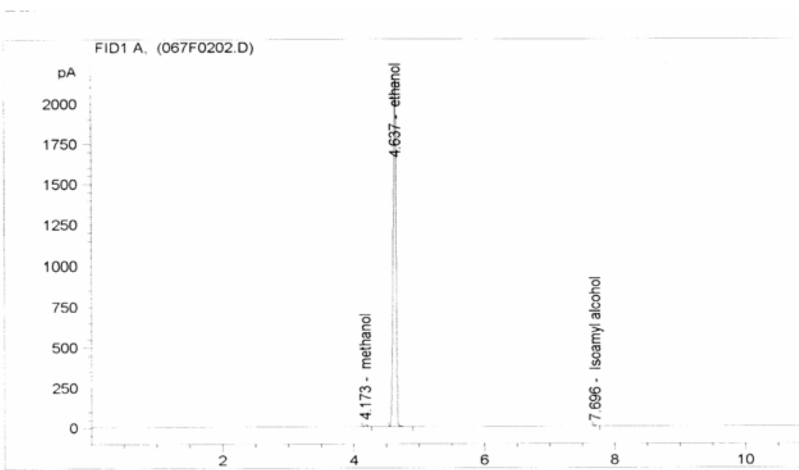
Figure 3a-c. GC chromatograms of the head, heart and tail cuts of Mixed Apples.



a. Peaks for the head cut.



b. Peaks for the heart cut.



c. Peaks for the tail cut.

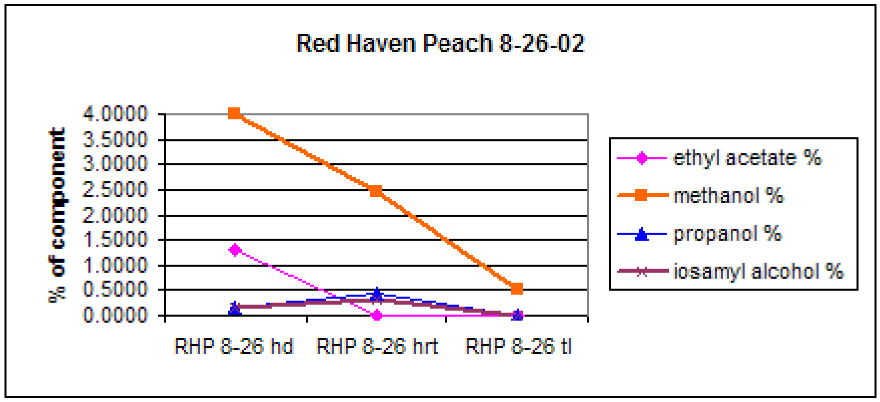
Figure 4a-c. GC chromatograms of head, heart and tail cuts of Red Delicious Apples.

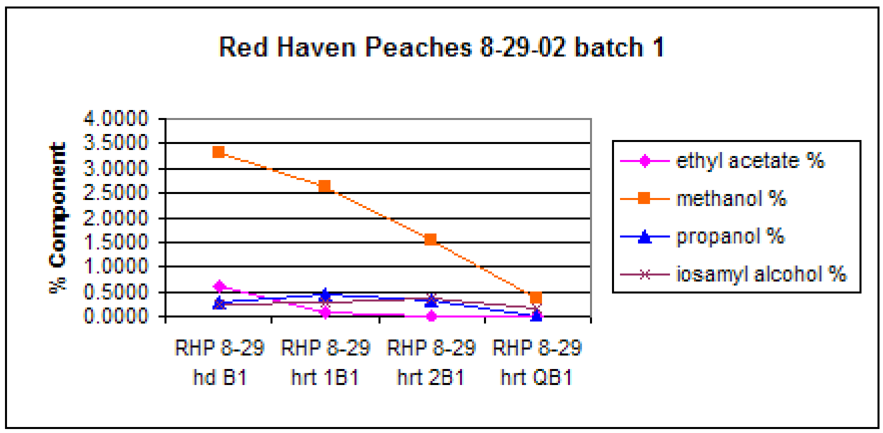
The total volume of alcohol collected and quantity of each cut varied with every variety of fruit. The starting sugar content and the fermentation process affected the total volume collected for each batch [1, 2]. A higher total volume of alcohol was collected when the sugar content was greater and fruit quality was good to fair. Table 2 shows the variety, fruit quality, and the pre and post-fermentation data.

Date	*Variety*	*Fruit Quality*	*°Brix*	*pH*	*% Titratable Acidity*	*Starting % Ethanol*
8-26-02	Red Haven Peaches	Fair/poor	11.5	3.85	0.75	5.2
8-29-02	Red Haven Peaches	Fair/poor	12.3	3.92	0.75	5.2
9-11-02	Gayla-Ozark Gold Apples	Good	12.4	3.58	0.39	5.8
9-12-02	Ozark Gold Apples	Good	12.4	3.58	0.39	5.7
9-13-02	Gayla Apples	Poor	14.2	3.9	0.35	7.6
9-13-02	Ozark Gold Apples	Good	12.2	3.55	0.40	5.8
9-18-02	Mixed Apples	Good	11.2	3.41	0.93	5.0
9-19-02	Mixed Apples	Good	11.2	3.47	0.92	5.2
10-1-02	Re-distilled Apple tail	-	-	-	-	40
10-7-02	Jonathon Apples	Fair/poor	14.9	3.22	0.93	7.8
10-8-02	Red Delicious Apples	Poor	12.8	4.08	0.22	5.0

Table 2. Pre and post-fermentation data for all mash distilled.

It was found that all distillates collected carried the distinctive aroma of the fruit from which they were made. However, some varieties showed more characteristics of the fruit than others. The lower and higher alcohol compounds such as ethyl acetate, methanol, isoamyl alcohol, and propanol with their pungent aromas can mask fruit character. This may be due in part to characteristics specific to a fruit variety, which causes greater production higher alcohols during fermentation, or could be caused by poor fruit quality and nutritional stress during fermentation. It was observed through GC analysis that the quality of fruit and conditions of fermentation appeared to have an affect on the quantity of methanol, propanol, and isoamyl alcohol content in the spirits produced. Figure 5 shows the definite increase in methanol content from the fair to poor quality Red Haven Peach fermentations. Figure 6 shows similar behavior with the Jonathon apples. It was noted that when two batches were distilled from the same mash, the second batch contained less of these pungent compounds. Figures 5 and 6 were produced from data in Table 3.





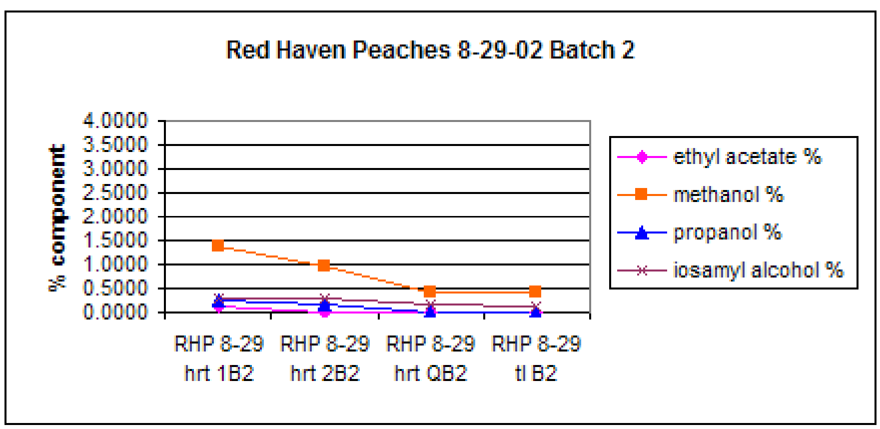
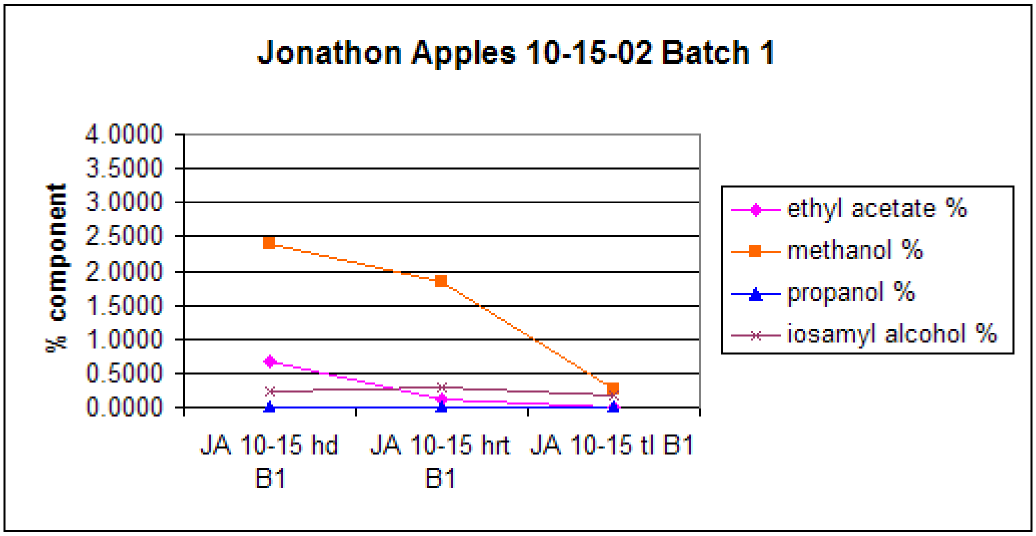


Figure 5. This series of charts show that in the single batch distillation of Red Haven Peaches component content, especially methanol, was higher. When distilled in two batches, the second batch carried a lower content of the same components.



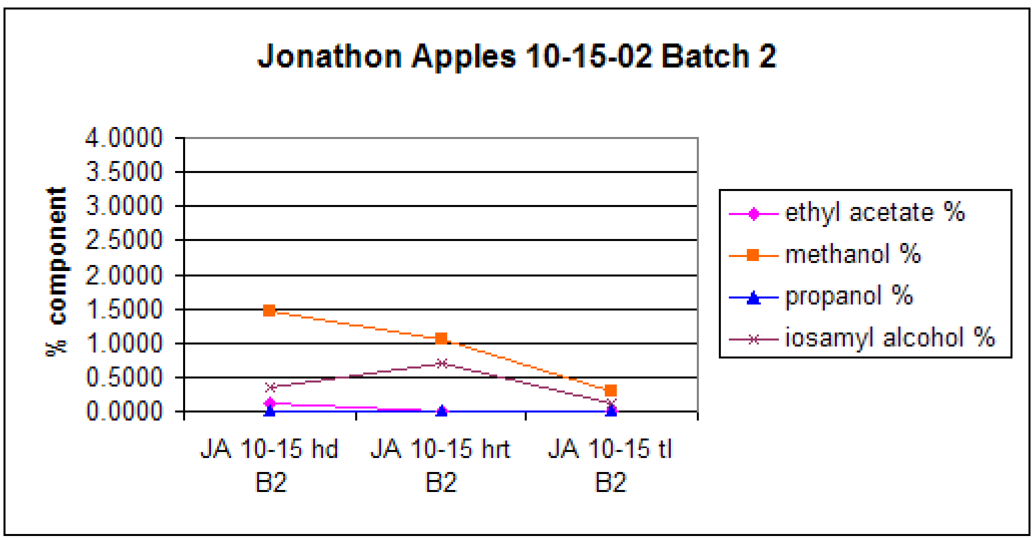


Figure 6. This figure demonstrates that content of each component except isoamyl alcohol in Batch 2 has decreased when compared to batch 1.

Also, the fruit aromas were found to be stronger by sensory analysis after a period of aging than they were at the time of collection. This is due to esterification that occurs during the aging process. Esters, fruity and aromatic aromas, are formed from a reaction of alcohol and acid producing water as a side product [1, 2].

Table 3. Gas Chromatography Analysis - average values of samples run in triplicate of Peach and Apple Varieties for specific components							
Sample name	**vial #**	**Acetone %**	**ethyl acetate %**	**methanol %**	**ethanol %**	**propanol %**	**isoamyl alcohol %**
RHP 8-26 hd	1	0.0000	1.3208	3.9887	153.9402	0.1616	0.1708
RHP 8-26 hrt	2	0.0000	0.0000	2.4413	138.8861	0.4259	0.3098
RHP 8-26 tl	3	0.0000	0.0000	0.5276	26.5440	0.0000	0.0000
RHP 8-29 hd B1	4	0.0000	0.5930	3.3089	158.6797	0.2904	0.2223
RHP 8-29 hrt 1B1	5	0.0000	0.0689	2.6322	155.4775	0.4257	0.2947
RHP 8-29 hrt 2B1	6	0.0000	0.0000	1.5372	102.4348	0.3369	0.3492
RHP 8-29 hrt QB1	7	0.0000	0.0000	0.3593	30.8045	0.0000	0.1748
RHP 8-29 hrt 1B2	8	0.0000	0.1427	1.3763	96.5018	0.2421	0.2857
RHP 8-29 hrt 2B2	9	0.0000	0.0000	0.9409	73.1038	0.1823	0.2834
RHP 8-29 hrt QB2	10	0.0000	0.0000	0.4089	36.7589	0.0064	0.1815
RHP 8-29 tl B2	11	0.0000	0.0000	0.4210	32.5816	0.0019	0.1090
GA 9-17 hd	12	0.0000	0.2907	1.0595	102.6390	0.0046	0.3516
GA 9-17 hrt	13	0.0000	0.0000	0.5983	70.0626	0.0000	0.3501
GA 9-17 tl	14	0.0000	0.0000	0.0073	14.6449	0.0000	0.0000
OGA 9-18 hd	15	0.0000	0.4932	0.4399	110.3227	0.0014	0.3193
OGA 9-18 hrt	16	0.0000	0.0000	0.1443	71.6514	0.0000	0.4144
OGA 9-18 tl	17	0.0000	0.0000	0.0000	18.5628	0.0000	0.0530
GA 9-19 F5 hd	18	0.0000	0.3786	0.9288	101.2485	0.0154	0.3644
GA 9-19 F5 hrt	19	0.0000	0.0000	0.6390	79.5180	0.0132	0.4762
GA 9-19 F5 tl	20	0.0000	0.0000	0.0065	15.5212	0.0000	0.0000
GA 9-19 F4 hd B1	21	0.0000	0.1199	0.7352	85.5962	0.0374	0.4988
GA 9-19 F4 hrt B1	22	0.0000	0.0000	0.3418	48.4812	0.0000	0.2764
GA 9-19 F4 hd B2	23	0.0000	0.1082	0.8779	99.0933	0.0501	0.4791
GA 9-19 F4 hrt B2	24	0.0000	0.0000	0.0000	14.4571	0.0000	0.0000
discarded	25						
OGA 9-20 hd B1	26	0.0000	0.1463	0.6399	110.1900	0.0153	0.3485
OGA 9-20 hrt B1	27	0.0000	0.0000	0.2851	84.4907	0.0352	0.5570
OGA 9-20 hd B2	28	0.0000	0.2579	0.5008	96.5380	0.0085	0.3622
OGA 9-20 hrt B2	29	0.0000	0.0000	0.3302	83.0862	0.0253	0.5379
OGA 9-20 tl B2	30	0.0000	0.0000	0.0000	15.6887	0.0000	0.0000
OGA 9-23 hd B1	31	0.0000	0.7991	0.8350	102.7094	0.0031	0.3255
OGA 9-23 hrt B1	32	0.0000	0.0000	0.4038	79.5883	0.0198	0.5718
OGA 9-23 tl B1	33	0.0000	0.0000	0.0000	16.4217	0.0000	0.0000
OGA 9-23 hd B2	34	0.0000	0.4056	0.6768	93.4750	0.0000	0.3440

Key to Table 3

OGA – Ozark Gold Apples
GA – Gayla Apples
RHP – Red Haven Peach
JA – Jonathon Apples
MA – Mixed Apples
RDA – Red Delicious Apples
RA – Redistilled Apple tails
hd – head cut
hrt – heart cut
tl – tail cut
B1 – Batch 1
B2 – Batch 2
Q – Questionable
F – Fermenter

Table 3 cont. Gas Chromatography Analysis - average values of samples run in triplicate of Peach and Apple Varieties for specific components							
Sample name	vial #	acetone %	ethyl acetate %	methanol %	ethanol %	propanol %	isoamyl alcohol %
OGA 9-23 hrt B2	35	0.0000	0.0000	0.4660	85.0363	0.0264	0.5827
OGA 9-23 tl B2	36	0.0000	0.0000	0.0000	15.9988	0.0000	0.0000
MA 9-26 hd B1	37	0.0000	0.2738	0.4295	106.2739	0.0000	0.3747
MA 9-26 hrt B1	38	0.0000	0.0000	0.2003	80.9828	0.0000	0.6638
MA 9-26 tl B1	39	0.0000	0.0000	0.0000	16.1132	0.0000	0.0000
MA 9-26 hd B2	40	0.0000	0.4067	0.4496	104.6932	0.0000	0.3068
MA 9-26 hrt B2	41	0.0000	0.0000	0.0000	18.7173	0.0000	0.0000
MA 9-26 tl B2	42	0.0000	0.0000	0.0000	14.5748	0.0000	0.0000
MA 9-30 hd B1	43	0.0000	0.2850	1.4124	104.4137	0.0000	0.2611
MA 9-30 hrt B1	44	0.0000	0.0000	0.3390	57.9630	0.0000	0.5698
discarded	45						
MA 9-30 hd B2	46	0.0000	0.0788	0.8566	86.5425	0.0000	0.3680
MA 9-30 hrt B2	47	0.0000	0.0000	0.3973	57.8812	0.0000	0.5042
MA 9-30 tl B2	48	0.0000	0.0000	0.0431	16.2020	0.0000	0.0000
RA 10-1 start F3	49	0.0000	0.0000	0.0877	16.6156	0.0000	0.0000
RA 10-1 start F4	50	0.0000	0.0000	0.0637	21.4493	0.0000	0.1614
RA 10-1 start F5	51	0.0000	0.0000	0.0021	19.5746	0.0000	0.0000
RA 10-1 start F6	52	0.0000	0.0000	0.0098	17.3776	0.0000	0.0000
RA 10-1 hd	53	0.0000	0.0000	3.5572	118.5678	0.0000	0.0000
RA 10-1 hrt	54	0.0000	0.0000	1.6893	112.4442	0.0000	0.1746
RA 10-1 tl	55	0.0000	0.0000	0.6216	37.1892	0.0000	0.0000
OGA 10-2 hd B1	56	0.0000	0.2862	0.9153	88.0864	0.0067	0.3394
OGA 10-2 hrt B1	57	0.0000	0.0000	0.4156	60.3868	0.0010	0.4841
OGA 10-2 tl B1	58	0.0000	0.0000	0.0000	16.5731	0.0000	0.0533
OGA 10-2 hd B2	59	0.0000	0.0705	0.6693	77.0723	0.0027	0.3763
OGA 10-2 hrt B2	60	0.0000	0.0000	0.7881	87.0852	0.0254	0.4537
OGA 10-2 tl B2	61	0.0000	0.0000	0.0922	22.8491	0.0000	0.1605
RDA 10-16 F2 hd B1	62	0.0000	0.1607	1.0912	106.7852	0.0013	0.2719
RDA 10-16 F2 hrt B1	63	0.0000	0.0000	0.9926	115.7983	0.0254	0.3419
RDA 10-16 F2f tl B1	64	0.0000	0.0000	0.0707	23.9576	0.0000	0.1619
RDA 10-16 F2 hd B2	65	0.0000	0.1583	0.7318	91.6002	0.0005	0.3132
RDA 10-16 F2 hrt B2	66	0.0000	0.0000	0.0917	27.2674	0.0000	0.1681
RDA 10-16 F2 tl B2	67	0.0000	0.0000	0.0879	25.5844	0.0000	0.1615
RDA 10-16 F3 hd B1	68	0.0000	0.1815	1.3980	114.5540	0.0000	0.2485
RDA 10-16 F3 hrt B1	69	0.0000	0.0000	1.1818	120.4874	0.0074	0.3239

Key to Table 3

OGA – Ozark Gold Apples
GA – Gayla Apples
RHP – Red Haven Peach
JA – Jonathon Apples
MA – Mixed Apples
RDA – Red Delicious Apples
RA – Redistilled Apple tails
hd – head cut
hrt – heart cut
tl – tail cut
B1 – Batch 1
B2 – Batch 2
Q – Questionable
F – Fermenter

Table 3 cont. Gas Chromatography Analysis - average values of samples run in triplicate of Peach and Apple Varieties for specific components							
Sample name	vial #	acetone %	ethyl acetate %	methanol %	ethanol %	propanol %	isoamyl alcohol %
RDA 10-16 F3 tl B1	70	0.0000	0.0000	0.0961	23.1569	0.0000	0.1604
RDA 10-16 F3 hd B2	71	0.0000	0.2057	1.1829	115.5504	0.0027	0.3377
RDA 10-16 F3 hrt B2	72	0.0000	0.0000	0.7289	100.2199	0.1088	0.5676
RDA 10-16 F3 tl B2	73	0.0000	0.0000	0.0872	23.2240	0.0000	0.1069
RDA 10-23 F4 hd B2	74	0.0000	0.0836	0.9789	87.1447	0.0000	0.4322
RDA 10-23 F4 hrt B2	75	0.0000	0.0000	1.0425	97.2328	0.0236	0.5714
RDA 10-23 F4 tl B2	76	0.0000	0.0000	0.2253	27.1043	0.0000	0.1669
RDA 10-23 F4 hd B1	77	0.0000	0.2524	1.9069	115.8866	0.0000	0.2524
RDA 10-23 F4 hrt B1	78	0.0000	0.0000	1.3995	116.7810	0.0247	0.4079
RDA 10-23 F4 tl B1	79	0.0000	0.0000	0.1760	23.8878	0.0000	0.1645
JA 10-15 hd B1	80	0.0000	0.6654	2.4043	131.2420	0.0000	0.2418
JA 10-15 hrt B1	81	0.0000	0.1074	1.8361	128.2821	0.0000	0.2936
JA 10-15 tl B1	82	0.0000	0.0000	0.2613	27.4043	0.0000	0.1694
JA 10-15 hd B2	83	0.0000	0.1177	1.4664	106.8810	0.0000	0.3368
JA 10-15 hrt B2	84	0.0000	0.0000	1.0556	95.6606	0.0015	0.7078
JA 10-15 tl B2	85	0.0000	0.0000	0.2785	26.1624	0.0000	0.1064

Key to Table 3

OGA – Ozark Gold Apples
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DISCUSSION AND CONCLUSIONS

The purpose of this portion of the project was to refine established methods to produce quality distillates of fruit brandy, and determine which cultivars of continued to show the most promise as a fruit distillate. Two types of distillates were studied, distillates that produce high quality sipping brandies and distillates that can be used to create other brandy products such as fruit ports and infusions. The highest quality portion of the distillate is found in the heart cut [2]. It possesses the most fruit character and the least amount of lower and higher alcohols that mask the fruit aromas of the fruit distilled.

No pattern for the location of cuts was determined to exist between different cultivars. However, it was found that the quality of the fruit had a definite impact on where the cuts were made and the quality and quantity of bandy made. It could not be determined in this study that all fruit required a specific quantity, 500ml for example, for the head cut based on any one set of parameters. To make cuts of a specific volume would have sacrificed the quality of the heart in many of the trials by increasing the amount of ethyl acetate in the heart. Also, setting specific quantities of heart to be collected after the head cut was made would have resulted in either a decrease in quantity of good heart, or a decrease in quality of the heart due to higher alcohols of musty, rancid odors present in the heart cut. It was found that sensory was the best method for locating where to make the cuts. An in-depth study of a particular variety will need to be conducted to determine if a pattern for the location of head, heart, and tail cuts exists within a specific cultivar.

The results show that there is great opportunity with extended study to determine specific patterns necessary to create quality distillates from an individual cultivar. This will allow production of higher quality, single-cultivar, brandies. However, blending brandies made from several different single-cultivar batches mingled components that made a better product in most cases than a single-cultivar brandy. For example the Gayla apple displayed a heavier mouth feel than the Jonathon apple. The Jonathon seemed to carrier a stronger apple essence. When the two were blended the resulting brandy had very nice apple essence and good mouth-feel. Even when the many cultivars were fermented together prior to distillation, the resulting product carried more positive characteristics than any single-cultivar batch. This determination was based on sensory evaluation of the all brandies produced in 2001 and 2002. This preliminary study of many cultivars of each, apple and peach, will lend itself to choosing a few specific cultivars for further study, as well as more advanced studies in blending practices of different cultivars. All varieties show promise as good fortifying brandies for other products such as fruit ports and fruit infusions.

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