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Influence of Container and Temperature to Wine Parameters During Storage of the Locally Produced Wines in the Bicol Region, Philippines

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Abstract: **The wine parameters of tropical fruit wines, distilled wines and tuba stored in plastic-low density polyethylene (LDPE), amber glass and colorless glass bottle kept in room temperature (average was 28^{0}C) and cold temperature (average was 4^{0}C) were determined after storing the wines for 94 days. The wine parameters that were monitored were pH, titratable acidity, volatile acidity, ethanol content, methanol content, total soluble solids and total plate count. The tropical fruit wines were influenced by the temperature and container in terms of pH, titratable acidity, ethanol content, and total soluble solids while the volatile acidity was affected by the container only. There was an increase in the pH and ethanol content when the wines were stored in cool temperature and amber glass bottle, the titratable acidity and total soluble solids increased when stored in room temperature and plastic container and the volatile acidity increased while stored in plastic container regardless of the temperature. The distilled wines were influenced by the container and temperature in the volatile acidity, ethanol content and total soluble solids only, the other parameters were not affected during the storage. The volatile acidity and total soluble solids increased when stored in room temperature and plastic container while the ethanol content was higher when stored in cold temperature and amber glass bottle. Tuba was affected by the temperature and container in terms of pH, titratable acidity, volatile acidity, ethanol content and total soluble solids. The titratable acidity and volatile acidity were higher when stored in room temperature and plastic bottles while the pH, ethanol content and total soluble solids were higher when stored in cold temperature and amber glass bottles. The changed in the wine parameters during the storage study contributed to the wine spoilage, the proposal given to the wine manufacturers discussed how the change will be addressed.**

Keywords: **container, temperature, storage stability, wine parameters.**

I. INTRODUCTION

Bicol Region has a Type II climate characterized by a very pronounced rainfall from November to April and wet during rest of the year [1]. This results to the growth of a variety of tropical fruits that were made into wine. The wine manufacturers are not aware of the influence of container and room temperature when they store their wines. The Research Coordinator of Bicol University Polangui Campus, Polangui Albay, Philippines mentioned that a bottle of wine exploded while it was kept in the store room and she is wondering what caused the explosion. The other wine manufacturers admire the presentation of colorless glass bottle because it is appealing to the eyes, but were not informed of the oxidative process happening in colorless bottles. Primary alcohols maybe oxidized to an aldehyde or carboxylic acid, vigorous oxidation leads to the formation of carboxylic acid, but there are a number of methods that permit us to stop oxidation at the intermediate aldehyde stage [2].

The influence of the container and temperature during storage on the wine parameters was discussed in food chemistry. Three factors are known to accelerate the oxidation of wine during storage, which are light, humidity and temperature. Strong, direct or incandescent light can adversely react with phenolic compounds in wine and create potential wine faults. Some degree of humidity is required in order to keep wines with cork enclosures from drying out. Even when wine bottles are stored on their sides, one side of the cork is still exposed to air. Should the cork begin to dry out, it can allow oxygen to enter the bottle, filling the ullage space and possibly causing the wine to spoil or oxidize. Wine is very susceptible to changes in temperature, with temperature control being an important consideration in wine storage. If the wine is exposed to too high a temperature (in excess of 25 °C) for long periods of time, it may be spoiled or become "cooked" and develop off-flavors that taste raisiny or stewed [3].

The influence of the container and packaging to the enological or wine parameters was determined after storing the wines in plastic (LDPE), colorless glass bottle and colored glass bottle for three (3) months and four (4) days. The data showed that the bottled and sealed wines stored in room temperature and cold temperature were not influenced in terms of the wine parameters. The wines that were transferred in plastic, colorless glass and colored glass bottles had a significant change in the pH, ethanol content, titratable acidity and volatile acidity and total soluble solids while the total plate count and methanol content were not influence by the container and temperature variation.

The result of the study was given back to the wine manufacturers and the researchers noted the problem on the ethanol content that was placed in the label being different from the actual ethanol content of the wine. To solve the problem the researchers trained the wine manufacturers how to measure the specific gravity, total dissolved solids and temperature to adjust the ethanol content of their produce and conform to the label in the wine bottle.

II. METHODS AND METHODOLOGY

***The Wine Bottles for Storage*:** The sealed and bottled wines and those transferred in plastic, colorless and colored glass bottles were stored at cold temperature and room temperature from October 7, 2014 to January 11, 2015, the average room temperature of the room was 28^0C and the average temperature of the refrigerator was 4^0C.

Analyses of the wine Parameters: The pH, titratable acidity, volatile acidity, ethanol content and total soluble solids were measured at Bicol University Tabaco Campus laboratory, Tabaco City, Philippines the pH was taken by glass electrode, titratable acidity and volatile acidity by titration, total soluble solids by refractometry and ethanol content by specific gravity method. The wine parameters were analyzed following the specified procedure in PNS/FDA 30:2010 for the pH, ethanol content, titratable acidity and total soluble solids [4]. The total plate count and methanol content were conducted at Intertek Services Laboratory, Makati City, Philippines using gas chromatography and disc injection methods.

Data Analysis: The data from the wine parameters gathered during the storage of the bottled and sealed wines in room and cold temperature were subjected to one-way ANOVA ($p>0.05$) while the wine parameters taken from the storage of the wine sample in plastic, colorless and colored bottles were subjected to two-way ANOVA and DMRT ($p>0.05$). To determine the significant difference in the wine parameters after storing in different conditions

Proposal for the Wine Manufacturers: The result of study was collated to formulate the proposal given to the wine manufacturers after the analyses of physico-chemical and microbiological parameters and storage stability study. The wine manufacturers were revisited to explain the results and the proposal and the proper way of measuring the temperature, specific gravity and ethanol content was given and demonstrated by the researchers.

III. RESULT AND DISCUSSION

The Wine Samples: There were 21 wine samples that were bottled and sealed for the storage in room and cold temperature that were coded the tuba from Masbate province were not included because they were stored in ordinary mineral water bottles. There were 22 wine samples that were transferred in plastic, colorless glass and colored glass bottle to determine the influence of the container and temperature to the wine parameters.

The Effect of Storage Temperature to the Wine Parameters: The data of the wine parameters of the tropical fruit wines and distilled wines after storing in cold and room temperature for 3 months and 4 days showed that the f calculated was less than the f critical for all tables, therefore there was no significant difference in the wine parameters of the tropical fruit wines and distilled wines stored in room and cold temperature. The wines were sealed by screw cap and cork making them stable when they were brought to different conditions. The tuba from Masbate Province that were stored in ordinary mineral water bottles and were not sealed were not included.

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***The Effect of Storage Temperature and Container to the pH*:** The pH value of the tropical fruit wine (Table 1 to 3) was affected by the container and temperature, there was a significant decrease in the pH value of the wine stored in plastic and room temperature. The pH value of the distilled wines (Table 4 to 6) were not affected by the container and temperature, there was no significant difference in the pH value of the wine. The pH value of tuba (Table 7 to 9) was affected by the container and temperature during the storage, there was a significant difference in the pH value of the wine.

Table 1: pH of tropical fruit wine as affected by storage temperature

Tropical Fruit Wine	Storage temperature		Mean
	cool	room	
A	3.763	3.683	3.723
B	3.760	3.667	3.713
F	3.783	3.607	3.695
G	3.787	3.660	3.723
H	3.787	3.770	3.778
I	3.783	3.757	3.770
J	3.813	3.783	3.798
K	3.370	3.347	3.358
L	3.383	3.357	3.370
M	3.813	3.780	3.797
N	3.790	3.770	3.780
O	3.430	3.420	3.425
P	4.073	4.060	4.067
Q	3.763	3.683	3.723
R	3.760	3.667	3.713
T	3.783	3.607	3.695
U	3.787	3.660	3.723
Mean	3.731	3.663	3.697

Table 2: pH of tropical fruit wine as affected by container

Tropical Fruit Wine	Container			Mean
	Amber	Plastic	Glass	
A	3.770	3.635	3.765	3.723
B	3.760	3.625	3.755	3.713
F	3.795	3.495	3.795	3.695
G	3.790	3.590	3.790	3.723
H	3.795	3.745	3.795	3.778
I	3.790	3.730	3.790	3.770
J	3.815	3.770	3.810	3.798
K	3.380	3.320	3.375	3.358
L	3.390	3.330	3.390	3.370
M	3.815	3.765	3.810	3.797
N	3.805	3.740	3.795	3.780
O	3.440	3.400	3.435	3.425
P	4.080	4.045	4.075	4.067
Q	3.770	3.635	3.765	3.723
R	3.760	3.625	3.755	3.713
T	3.795	3.495	3.795	3.695
U	3.790	3.590	3.790	3.723
Mean	3.738	3.620	3.734	3.697

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Table 3: pH of tropical wine as affected by storage temperature and container

Tropical Fruit Wine				
Storage temperature	**Container**			**Mean**
	Amber	**Plastic**	**Glass**	
Cool	3.735	3.676	3.733	3.714
Room	3.701	3.642	3.699	3.680
Mean	3.718	3.659	3.716	3.697

Table 4: pH of distilled wine as affected by storage temperature

Distilled Wine	**Storage temperature**		Mean
	cool	room	
C	3.800	3.613	3.707
D	3.787	3.607	3.697
E	3.717	3.540	3.629
S	3.200	3.173	3.187
Mean	3.626	3.483	3.555

Table 5:pH of distilled wine as affected by container

Distilled Wine	**Container**			Mean
	Amber	Plastic	Glass	
C	3.805	3.515	3.800	3.707
D	3.790	3.510	3.790	3.697
E	3.730	3.435	3.720	3.628
S	3.210	3.150	3.200	3.187
Mean	3.634	3.403	3.628	3.555

Table 6: pH of distilled wine as affected by storage temperature and container

Distilled Wine				
Storage temperature	**Container**			Mean
	Amber	Plastic	Glass	
Cool	3.630	3.510	3.630	3.590
Room	3.560	3.440	3.560	3.520
Mean	3.595	3.475	3.595	3.555

Table 7: pH of tuba as affected by storage temperature

TUBA	**Storage temperature**		Mean
	cool	room	
V	3.770	3.543	3.657
W	3.740	3.240	3.490
X	3.880	3.443	3.662
Y	3.787	3.757	3.772
Z	3.440	3.363	3.402
Mean	3.723	3.469	3.596

Table 8: pH of tuba as affected by container

TUBA	**Container**			Mean
	Amber	Plastic	Glass	
V	3.670	3.645	3.655	3.657
W	3.525	3.475	3.470	3.490
X	3.645	3.615	3.725	3.662
Y	3.790	3.765	3.760	3.772
Z	3.410	3.400	3.395	3.402
Mean	3.608	3.580	3.601	3.596

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Table 9: pH of tuba as affected by storage temperature and container

TUBA				
Storage temperature	**Container**			Mean
	Amber	Plastic	Glass	
Cool	3.666	3.652	3.662	3.660
Room	3.539	3.525	3.535	3.533
Mean	3.603	3.589	3.599	3.597

***The Effect of Storage Temperature and Container to the Titratable Acidity (TA)*:** The titratable acidity of the tropical fruit wines (Table 10 to 12) was affected by the container and temperature, there was a significant increase in the titratable acidity of the wine stored in plastic and room temperature. The titratable acidity of the distilled wines (Table 13 to 15) was not affected by the container and temperature, there was no significant difference in the TA of the distilled wines. The titratable acidity of tuba (16 to 18) was affected by the container and temperature, there was a significant difference in the TA of the tuba.

Table 10: Titratable acidity of tropical fruit wine as affected by storage temperature

Tropical Fruit Wine	**Storage temperature**		**Mean**
	cool	**room**	
A	0.344	0.361	0.353
B	0.344	0.443	0.394
F	1.281	1.364	1.323
G	0.510	0.600	0.555
H	0.897	0.977	0.937
I	0.675	0.759	0.717
J	0.504	0.584	0.544
K	1.137	1.215	1.176
L	0.505	0.586	0.546
M	0.471	0.581	0.526
N	0.417	0.497	0.457
O	0.982	1.095	1.039
P	0.413	0.500	0.457
Q	0.344	0.361	0.353
R	0.344	0.443	0.394
T	1.281	1.364	1.323
U	0.510	0.600	0.555
Mean	0.645	0.725	0.685

Table 11: Titratable acidity of tropical fruit wine as affected by container

Tropical Fruit Wine	**Container**			**Mean**
	Amber	**Plastic**	**Glass**	
A	0.345	0.366	0.347	0.353
B	0.346	0.488	0.348	0.394
F	1.275	1.409	1.277	1.320
G	0.506	0.648	0.506	0.553
H	0.894	1.019	0.894	0.936
I	0.670	0.804	0.674	0.716
J	0.500	0.625	0.503	0.543
K	1.133	1.255	1.135	1.174
L	0.501	0.630	0.503	0.545
M	0.450	0.621	0.453	0.508
N	0.415	0.540	0.416	0.457
O	0.950	1.125	0.970	1.015
P	0.405	0.544	0.410	0.453
Q	0.345	0.366	0.347	0.353
R	0.346	0.488	0.348	0.394

T	1.275	1.409	1.277	1.320
U	0.506	0.648	0.506	0.553
Mean	0.639	0.764	0.642	0.682

Table 12: Titratable acidity of tropical wine as affected by storage temperature and container

Tropical Fruit Wine				
Storage temperature	**Container**			**Mean**
	Amber	**Plastic**	**Glass**	
Cool	0.642	0.705	0.644	0.664
Room	0.682	0.745	0.684	0.704
Mean	0.662	0.725	0.664	0.684

Table 13: Titratable acidity of distilled wine as affected by storage temperature

Distilled Wine	**Storage temperature**		Mean
	cool	room	
C	0.233	0.413	0.323
D	0.183	0.336	0.260
E	0.145	0.297	0.221
S	0.218	0.298	0.258
Mean	0.195	0.336	0.265

Table 14: Titratable acidity of distilled wine as affected by container

Distilled Wine	**Container**			Mean
	Amber	Plastic	Glass	
C	0.250	0.370	0.316	0.312
D	0.199	0.318	0.241	0.253
E	0.161	0.276	0.205	0.214
S	0.217	0.298	0.244	0.253
Mean	0.265	0.265	0.265	0.265

Table 15: Titratable acidity of distilled wine as affected by storage temperature and container

Distilled Wine				
Storage temperature	**Container**			Mean
	Amber	Plastic	Glass	
Cool	0.230	0.230	0.230	0.230
Room	0.301	0.301	0.301	0.301
Mean	0.266	0.266	0.266	0.266

Table 16: Titratable acidity of tuba as affected by storage temperature

TUBA	**Storage temperature**		Mean
	cool	room	
V	0.902	2.900	1.901
W	0.868	3.443	2.156
X	0.903	3.300	2.102
Y	1.003	1.333	1.168
Z	1.367	3.133	2.250
Mean	1.009	2.822	1.915

Table 17: Titratable acidity of tuba as affected by container

TUBA	**Container**			Mean
	Amber	Plastic	Glass	
V	1.650	2.253	1.800	1.901
W	1.965	2.403	2.100	2.156
X	1.800	2.405	2.100	2.102

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Y	1.050	1.105	1.350	1.168
Z	1.950	2.150	2.650	2.250
Mean	1.683	2.063	2.000	1.915

Table 18: Titratable acidity of tuba as affected by storage temperature and container

TUBA				
Storage temperature	**Container**			Mean
	Amber	Plastic	Glass	
Cool	1.346	1.536	1.505	1.462
Room	2.253	2.443	2.411	2.369
Mean	1.799	1.989	1.958	1.915

***The Effect of Storage Temperature and Container to the Volatile Acidity (VA)*:** The volatile acidity of the tropical fruit wines (Table 19 to 21) was affected by the container and temperature, there was a significant increase in the volatile acidity of the wine. The volatile acidity of the distilled wines (Table 22 to 24) was not affected by temperature whereas, the container affected the volatile acidity of the wines during the storage, and there was a significant increase in the volatile acidity of the wine stored in plastic bottle. The volatile acidity of tuba (Table 25 to 27) was affected by the container and temperature, there was a significant increase in the volatile acidity of the tuba in plastic and room temperature.

Table 19: Volatile acidity of tropical fruit wine as affected by storage temperature

Tropical Fruit Wine	**Storage temperature**		**Mean**
	cool	**room**	
A	0.141	0.142	0.142
B	0.142	0.143	0.143
F	0.499	0.501	0.500
G	0.266	0.269	0.268
H	0.102	0.105	0.104
I	0.405	0.408	0.407
J	0.336	0.338	0.337
K	0.465	0.466	0.466
L	0.264	0.265	0.265
M	0.264	0.265	0.265
N	0.119	0.120	0.120
O	0.626	0.628	0.627
P	0.266	0.269	0.268
Q	0.300	0.301	0.301
R	0.141	0.142	0.142
T	0.142	0.143	0.143
U	0.499	0.501	0.500
Mean	0.266	0.269	0.268

Table 20: Volatile acidity of tropical fruit wine as affected by container

Tropical Fruit Wine	**Container**			**Mean**
	Amber	**Plastic**	**Glass**	
A	0.140	0.142	0.142	0.141
B	0.142	0.144	0.143	0.143
F	0.499	0.502	0.501	0.501
G	0.267	0.269	0.269	0.268
H	0.103	0.106	0.106	0.105
I	0.406	0.409	0.408	0.408
J	0.337	0.339	0.338	0.338
K	0.464	0.466	0.466	0.465
L	0.264	0.265	0.265	0.265
M	0.264	0.266	0.265	0.265
N	0.119	0.120	0.120	0.120

O	0.626	0.629	0.629	0.628
P	0.267	0.269	0.269	0.268
Q	0.140	0.142	0.142	0.141
R	0.142	0.144	0.143	0.143
T	0.499	0.502	0.501	0.501
U	0.267	0.269	0.269	0.268
Mean	0.291	0.293	0.293	0.292

Table 21: Volatile acidity of tropical wine as affected by storage temperature and container

Tropical Fruit Wine				
Storage temperature	**Container**			**Mean**
	Amber	**Plastic**	**Glass**	
Cool	0.279	0.280	0.280	0.280
Room	0.280	0.281	0.281	0.281
Mean	0.280	0.281	0.281	0.280

Table 22: Volatile acidity of distilled wine as affected by storage temperature

Distilled Wine	**Storage temperature**		Mean
	cool	room	
C	0.336	0.338	0.337
D	0.142	0.144	0.143
E	0.108	0.11	0.109
S	0.211	0.217	0.214
Mean	0.199	0.202	0.201

Table 23: Volatile acidity of distilled wine as affected by container

Distilled Wine	**Container**			Mean
	Amber	Plastic	Glass	
C	0.335	0.34	0.336	0.337
D	0.141	0.146	0.142	0.143
E	0.107	0.112	0.108	0.109
S	0.212	0.219	0.213	0.215
Mean	0.199	0.204	0.200	0.201

Table 24: Volatile acidity of distilled wine as affected by storage temperature and container

Distilled Wine				
Storage temperature	**Container**			Mean
	Amber	Plastic	Glass	
Cool	0.199	0.202	0.200	0.200
Room	0.201	0.203	0.201	0.202
Mean	0.200	0.203	0.201	0.201

Table 25: Volatile acidity of tuba as affected by storage temperature

TUBA	**Storage temperature**		Mean
	cool	room	
V	0.211	0.214	0.213
W	0.107	0.109	0.108
X	0.101	0.103	0.102
Y	0.102	0.104	0.103
Z	0.101	0.104	0.103
Mean	0.124	0.127	0.126

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Table 26: Volatile acidity of tuba as affected by container

TUBA	Container			Mean
	Amber	Plastic	Glass	
V	0.211	0.217	0.127	0.185
W	0.107	0.111	0.112	0.110
X	0.101	0.106	0.113	0.107
Y	0.102	0.107	0.114	0.108
Z	0.102	0.107	0.116	0.108
Mean	0.125	0.130	0.116	0.124

Table 27: Volatile acidity of tuba as affected by storage temperature and container

TUBA				
Storage temperature	Container			Mean
	Amber	Plastic	Glass	
Cool	0.125	0.127	0.120	0.124
Room	0.126	0.129	0.122	0.125
Mean	0.126	0.128	0.121	0.125

***The Effect of Storage Temperature and Container to the Ethanol Content (EC)*:** The ethanol content of the tropical fruit wines (Table 28 to 30) were affected by the container and temperature, there was a significant decrease in the ethanol content of the wine stored in plastic and room temperature. The ethanol content of the distilled wines (Table 31 to 33) was affected by the temperature and container, there was a significant decrease in the ethanol content of the distilled wine stored in plastic and room temperature. The container and temperature greatly affected the ethanol content of tuba (Table 34 to 36), there was a significant decrease in the ethanol content of the tuba in plastic and room temperature.

Table 28: Ethanol content of tropical fruit wine as affected by storage temperature

Tropical Fruit Wine	Storage temperature		Mean
	cool	room	
A	6.267	6.100	6.184
B	6.300	6.167	6.234
F	11.367	11.100	11.234
G	14.500	14.333	14.417
H	12.400	11.400	11.900
I	10.633	10.367	10.500
J	12.800	12.667	12.734
K	18.667	18.533	18.600
L	14.567	14.433	14.500
M	14.033	13.700	13.867
N	17.433	17.133	17.283
O	12.867	12.533	12.700
P	14.533	14.400	14.467
Q	6.267	6.100	6.184
R	6.300	6.167	6.234
T	11.367	11.100	11.234
U	14.500	14.333	14.417
Mean	12.047	11.798	11.923

Table 29: Ethanol content of tropical fruit wine as affected by container

Tropical Fruit Wine	Container			Mean
	Amber	Plastic	Glass	
A	6.300	5.950	6.300	6.183
B	6.300	6.100	6.300	6.233
F	11.550	10.850	11.110	11.170
G	14.600	14.150	14.310	14.353
H	13.000	11.100	11.840	11.980

I	10.800	10.200	10.420	10.473
J	13.000	12.300	12.560	12.620
K	18.800	18.300	18.480	18.527
L	14.700	14.100	14.340	14.380
M	14.300	13.400	13.740	13.813
N	17.700	16.850	17.150	17.233
O	13.250	12.050	12.490	12.597
P	14.600	14.200	14.360	14.387
Q	6.300	5.950	6.300	6.183
R	6.300	6.100	6.300	6.233
T	11.550	10.850	11.110	11.170
U	14.600	14.150	14.310	14.353
Mean	12.215	11.565	11.848	11.876

Table 30: Ethanol content of tropical wine as affected by storage temperature and container

Tropical Fruit Wine				
Storage temperature	**Container**			**Mean**
	Amber	**Plastic**	**Glass**	
Cool	12.131	11.806	11.948	11.962
Room	12.007	11.682	11.823	11.837
Mean	12.069	11.744	11.886	11.900

Table 31: Ethanol content of distilled wine as affected by storage temperature

Distilled Wine	**Storage temperature**		Mean
	cool	room	
18.100	18.100	17.667	17.884
30.800	30.800	30.367	30.584
17.600	17.600	17.100	17.350
24.867	24.867	24.500	24.684
Mean	22.842	22.409	22.625

Table 32: Ethanol content of distilled wine as affected by container

Distilled Wine	**Container**			Mean
	Amber	Plastic	Glass	
C	18.150	17.450	18.050	17.883
D	31.000	29.950	30.800	30.583
E	17.700	16.800	17.550	17.350
S	25.150	24.200	25.100	24.817
Mean	23.000	22.100	22.875	22.658

Table 33: Ethanol content of distilled wine as affected by storage temperature and container

Distilled Wine				
Storage temperature	**Container**			Mean
	Amber	Plastic	Glass	
Cool	11.521	11.523	11.522	11.522
Room	11.305	11.306	11.305	11.305
Mean	11.413	11.414	11.413	11.413

Table 34: Ethanol content of tuba as affected by storage temperature

TUBA	**Storage temperature**		Mean
	cool	room	
V	3.633	3.267	3.450
W	3.567	3.167	3.367
X	3.600	3.133	3.367
Y	3.567	3.167	3.367
Z	3.633	3.100	3.367
Mean	3.600	3.167	3.383

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Table 35: Ethanol content of tuba as affected by container

TUBA	Container			Mean
	Amber	Plastic	Glass	
V	3.650	3.100	3.600	3.450
W	3.550	3.050	3.500	3.367
X	3.600	2.950	3.550	3.367
Y	3.650	2.850	3.600	3.367
Z	3.650	2.850	3.600	3.367
Mean	3.620	2.960	3.570	3.383

Table 36: Ethanol content of tuba as affected by storage temperature and container

TUBA				
Storage temperature	Container			Mean
	Amber	Plastic	Glass	
Cool	3.610	3.280	3.585	3.492
Room	3.394	3.064	3.369	3.275
Mean	3.502	3.172	3.477	3.383

***The Effect of Storage Temperature and Container to the Total Sluble Solids (TSS)*:** The TSS of the tropical fruit wines (Table 37 to 39) were affected by the container and temperature, there was a significant increase in the TSS of the wine stored in plastic and room temperature. The TSS of the distilled wines (Table 40 to 42) was affected by the temperature and container, there was a significant increase in the total soluble solids in the wine stored in plastic and room temperature. The container and temperature greatly affected the total soluble solids of tuba during the storage, there was a significant increase in the total soluble solids of the tuba in plastic and room temperature.

Table 37: Total soluble solids of tropical fruit wine as affected by storage temperature

Tropical Fruit Wine	Storage temperature		Mean
	cool	room	
A	11.600	11.673	11.637
B	12.500	12.553	12.527
F	15.000	15.093	15.047
G	3.820	3.843	3.832
H	7.750	7.810	7.780
I	11.600	11.720	11.660
J	8.500	8.637	8.568
K	5.830	5.877	5.853
L	3.820	3.893	3.857
M	3.820	3.920	3.870
N	10.100	10.213	10.157
O	12.500	12.610	12.555
P	11.600	11.680	11.640
Q	11.600	11.673	11.637
R	12.500	12.553	12.527
T	15.000	15.093	15.047
U	3.820	3.843	3.832
Mean	9.492	9.570	9.531

Table 38: Total soluble solids of tropical fruit wine as affected by container

Tropical Fruit Wine	Container			Mean
	Amber	Plastic	Glass	
A	11.605	11.660	11.645	11.637
B	12.500	12.555	12.525	12.527
F	15.000	15.095	15.045	15.047
G	3.820	3.855	3.820	3.832
H	7.750	7.820	7.770	7.780

I	11.640	11.695	11.645	11.660
J	8.545	8.605	8.555	8.568
K	5.830	5.890	5.840	5.853
L	3.820	3.900	3.850	3.857
M	3.850	3.905	3.855	3.870
N	10.130	10.195	10.145	10.157
O	12.525	12.595	12.545	12.555
P	11.600	11.660	11.660	11.640
Q	11.605	11.660	11.645	11.637
R	12.500	12.555	12.525	12.527
T	15.000	15.095	15.045	15.047
U	3.820	3.855	3.820	3.832
Mean	9.502	9.564	9.526	9.531

Table 39: Total soluble solids of tropical wine as affected by storage temperature and container

Tropical Fruit Wine				
Storage temperature	**Container**			**Mean**
	Amber	**Plastic**	**Glass**	
Cool	9.497	9.528	9.509	9.511
Room	9.536	9.567	9.548	9.550
Mean	9.517	9.548	9.529	9.531

Table 40: Total soluble solids of distilled wine as affected by storage temperature

Distilled Wine	**Storage temperature**		Mean
	cool	room	
18.100	8.500	8.877	8.688
30.800	9.900	10.120	10.010
17.600	7.950	10.023	8.987
24.867	8.760	8.837	8.798
Mean	8.778	9.464	9.121

Table 41: Total soluble solids of distilled wine as affected by container

Distilled Wine	**Container**			Mean
	Amber	Plastic	Glass	
C	8.650	8.740	8.675	8.688
D	9.990	10.045	9.995	10.010
E	9.445	9.015	8.975	9.145
S	8.775	8.835	8.785	8.798
Mean	9.215	9.159	9.108	9.160

Table 42: Total soluble solids of distilled wine as affected by storage temperature and container

Distilled Wine				
Storage temperature	**Container**			Mean
	Amber	Plastic	Glass	
Cool	8.997	8.969	8.943	8.969
Room	9.340	9.312	9.286	9.312
Mean	9.168	9.140	9.115	9.141

The Effect of Temperature and Container to the Methanol Content and Total Plate Count: There was no detection of methanol for all the wines samples stored in plastic, amber or colored glass and colorless glass bottle. As stated by Belitz, et. al. methanol is a by-product in the fermentation of tropical fruit wines specifically fruits high in pectin and the first distillate that comes out during the distillation of coconut sap or nipa sap because of its low boiling point [5]. The container and temperature did not produce methanol in the wine samples during the storage of the wine. The wines were stored in sterilized bottles and sealed with screw cap during the sampling the researchers were aware of the possible contamination of the pathogens to the wine samples. The samples had no detection for bacteria in the total plate count, indicating clean and sanitized equipment were used by the wine manufacturers and the guidelines for hygiene was followed.

The Proposal to the Wine Manufacturers: The proposal that was given back to the wine manufacturers highlighted the wine parameters that were affected by the container and temperature. The non-stable wine parameters will cause wine spoilage and must be given attention during the processing, packaging and handling of the wines. The common problem observed among the wine manufacturers is the erroneous ethanol content that was placed in the label, to solve the problem the researchers trained the wine manufacturers in measuring ethanol content using a hydrometer with the aid of a thermometer and graduated cylinder.

IV. CONCLUSION

The influence of the room temperature (average for Tabaco City was 28^0C from October 7, 2014 to January 11, 2015) and cold temperature (average temperature of the refrigerator was 4^0C) and plastic (LDPE) bottle, colorless glass bottle and colored (amber) glass bottle to the pH, titratable acidity, volatile acidity, total soluble solids, ethanol content, methanol content and total plate count was considered. There was no significant difference in the wine parameters when the sealed and bottle wines were stored in room and cold temperature. However, the wine parameters pH, ethanol content, titratable acidity, volatile acidity and total soluble solids significantly changed when the wines were stored in plastic, colored and colorless bottles at room and cold temperature. The non-stable wine parameters will cause wine spoilage and must be given attention during the processing, packaging and handling of the wines. This was mentioned in the proposal that was given back to the wine manufacturers. Further studies on the compliance to the suggested processing, packaging and handling must be done.

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