Dessert Wine from Purple Taro and Black Glutinous Rice:

A Health Drink

The making of Wine as Health Drink

Benefits of alcohol in general have been overlooked or underplayed

As a result, many people today believe that all alcohol is harmful to their health and merely mentioning the word evokes a negative reaction

It is important to differentiate the use of alcohol for medical applications versus excessive drinking or alcohol abuse

http://www.drkaslow.com/html/alcohol_in_supplements.html

The making of Wine as Health Drink

Regular consumption of red wine reduces mortality from coronary heart disease due to the anti-thrombotic effects of ethanol and to the antioxidant properties of polyphenolic compounds present in red wine.

Khan et. al. (2002)

The making of Wine as Health Drink

The phytochemicals in red wine are free radical scavengers which reduce the effect of harmful oxidants by binding to them, thus decreasing their destructive power (Mann, 1987)

The making of Wine as Health Drink

Technically alcohol can also be classified as a nutrient because it provides a source of energy (Alcohol contains about 7 calories per gram)

The making of Wine as Health Drink

Recently,

Red wine consumption can significantly modulate the growth of selected gut microbiota in humans diet which suggest possible prebiotic benefits associated with the inclusion of red wine polyphenols;

Red wine seemed to inhibit the growth of a group of bacteria (*Clostridium*) associated with colon cancer and inflammatory bowel disease (Queipo-Ortuno et. al. ,2012)

(*Am J Clin Nutr 2012;95:1323–34. Printed in USA. 2012 American Society for Nutrition*).

Why Taro with Rice?

- **Enhancing the functional characteristics of rice wine with taro, being one of the best known prebiotic rootcrops among all rootcrops**
  - **Presence of non-digestible polysaccharide such as pentosans and dietary fiber have qualified taro to be a potential substrate for beneficial microorganisms in the human intestines in addition to its nutrients such as proteins, vitamins and minerals**
- **Taro lacks the purple color which is believed to contribute antioxidant property in wine**

Raw Materials for Taro-Rice Wine

Taro *(VG-9)*

Black/Red Glutinous Rice *(Arabon)*

Grated Taro and Cooked Taro-Rice Mixture

Grated Taro

Cooked Shredded Taro and Black Rice Mixture

Microorganisms in *rage tape*

- ***Amylomyces rouxii*** was the principal fungus for saccharification and liquefaction of rice starch
- ***Mucor indicus*** dominant at early stage of fermentation
- ***Saccharomycopsis fibuligera*** dominant yeast in saccharification
- ***Saccharomyces cerevisiae, Candida glabrata, Pichia anomala*** **and** ***Issatchenkia orientalis*** dominant yeasts at the later stage of fermentation
- **Lactic acid bacteria (LAB)**
- ***Weissella*** **spp.**
- ***Pediococcus pentosaceus***
- ***Enterococcus faecium***

Nengah Sujaya et al., 1998

Microbial Starters

Rage Tape (Bali, Indonesia)

Saccharomyces cerevisiae

Methods of Fermentation

- **(OSF1) - One-stage fermentation with only 1 inoculum (*rage tape* only)**
- **(OSF2) - One-stage fermentation with 2 inocula (*rage tape* and *Saccharomyces cerevisiae* in simultaneous inoculation)**
- **(TSF) - Two-stage fermentation with *rage tape* (solid-state) and *Saccharomyces cerevisiae (liquid state) inoculated one after the other***

Fermentation Set-up (OSF1)

Note: **OSF2 makes use of two inocula**

Two-Stage Fermentation (TSF)

Steps:

One-stage fermentation

Juice is collected

Anaerobic fermentation with *Saccharomyces cerevisiae*

Physico-chemical properties of wine produced using different fermentation method

Treatment	TSS	pH	TTA	Alcohol Content
OSF1	26.40^{a}	3.625^{b}	0.972^{a}	6.765^{c}
OSF2	23.05^{b}	4.072^{a}	0.600^{b}	10.032^{b}
TSF	11.16^{c}	3.875^{ab}	0.685^{b}	13.060^{a}

Mean values within a column superscripted by the same letter are not significantly different at $p < 0.05$

Sensory Properties of the wine produced using different fermentation method

Treatment	Color ns	Aroma ns	Sweetness	Sourness	Alcohol ns	Flavor	Gen Accep
OSF1	7.13^{a}	7.30^{a}	**7.67^{a}**	**7.33^{a}**	7.00^{a}	**7.57^{a}**	**7.53^{a}**
OSF2	6.80^{a}	7.27^{a}	6.40^{b}	6.40^{b}	6.67^{a}	6.40^{b}	6.70^{b}
TSF	6.70^{a}	7.30^{a}	5.93^{b}	5.93^{b}	6.53^{a}	5.77^{b}	5.97^{c}

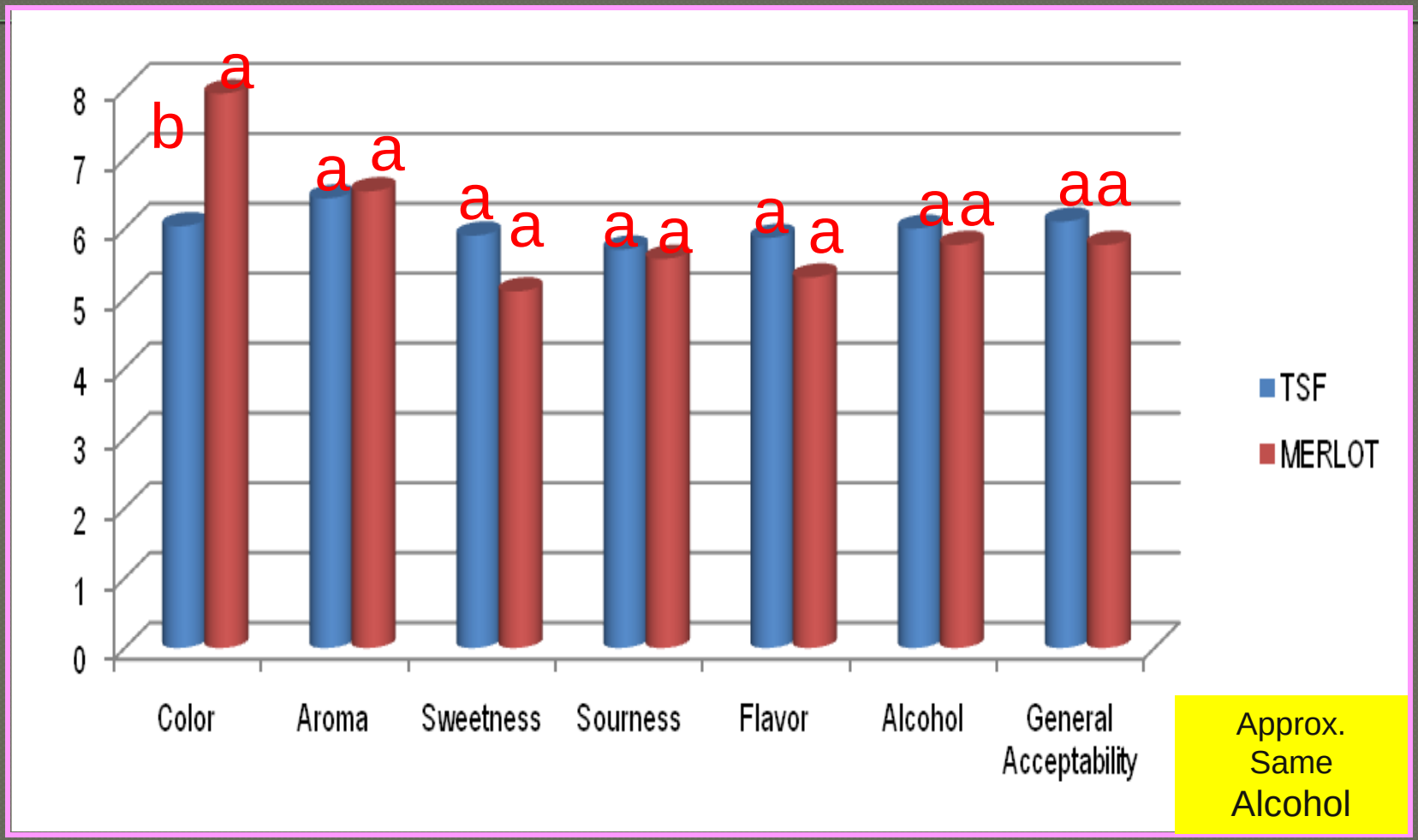
Mean values within a column superscripted by the same letter are not significantly different at $p < 0.05$; Scores: 1 (dislike extremely) to 9 (like extremely); Scores 7 – 8 (like moderately to like very much).

Comparative physico-chemical analyses between Taro Wine and Commercial Wine

Sample	TSS	pH	TTA	Alcohol Content
OSF1	26.40 ^{a}	3.62^{c}	0.97^{a}	6.76^{e}
OSF2	23.05 ^{b}	4.07^{a}	0.60^{a}	10.03^{c}
TSF	11.16 ^{d}	3.88^{b}	1.38^{a}	13.06^{a}
Novellino	11.35^{dc}	3.32^{d}	0.67^{a}	7.04^{e}
Merlot Varietal Range	7.60 ^{g}	3.36^{d}	1.38^{a}	13.50^{a}
Spanish gate	8.50 ^{f}	3.42^{d}	1.17^{a}	11.00^{b}
Bellagio	12.00 ^{c}	3.40^{d}	1.31^{a}	8.50^{d}
Natalie Sweet	10.20 ^{e}	3.34^{d}	1.11^{a}	6.00^{f}

Mean values within a column superscripted by the same letter are not significantly different at $p < 0.05$.

Sensory Evaluation between TSF and Merlot



Bars with the same letter in each sensory attribute are not significantly different at $p < 0.05$

SUMMARY RESULT OF CONSUMER ACCEPTABILITY
Taro wine (50% OSF1 & 50% TSF) vs. Novellino

By Age and Gender (General Consumers)	
Female (21 -40 years old) • Novellino wine had the highest average rating(all wine attributes)	Male (21 -40 years old) • Novellino wine had the highest average rating (all wine attributes)
Female (41 years old and above) • Color, aroma, texture and overall quality- Novellino wine had the highest average rating •Taste and aftertaste- taro wine had the highest average rating	Male (41 years old and above) • Color and aroma- Novellino wine had the highest average rating •Taste , texture, aftertaste,& overall quality- taro wine had the highest average rating

Functional Properties of Taro Wine (OSF1)

Parameter	Content
Phytonutrients	
Total Polyphenols (mg gallic acid/100g)	**118.5 ± 0.5**
Flavonoids (mg catechin/100g)	**146.6 ± 2.4**
Anthocyanidin (mg catechin/100g)	**14.6 ± 0.1**
Antioxidant Activity	
2,2-Diphenyl1- Picrilhydrazyl (DPPH), % Inhibition	**30.7 ± 0.6**
Ferric Reducing Antioxidant Power (FRAP), mg Trolox/100g	**15.8 ± 0.3**
Glycemic Index (GI)	**100 ± 3**

Physico-chemical characteristics and yield of taro wine with different levels of taro and mixing of substrate during fermentation

Treatment	Yield	TSS	pH	TTA	Alcohol %
100% taro	460b	6.60c	3.34d	0.82c	4.81a
50:50 Taro:Rice	443b	29.60a	3.77a	1.20b	5.32a
Mixed every 2 days	750a	26.90b	3.55c	1.67a	5.86a
Mixed Daily	695a	26.15b	3.61b	1.63a	5.36a

High GI

Anthocyanidin (mg catechin/100g) of taro wine in comparison with other food items

Food Description	Cyanidin (mg/100g)
Taro Wine	14.6
Sweet potato purple, cooked	10.6
Alcoholic beverage:	
Wine, table, red	0.45
White	0.00
Guava jams and preserves	0.20
Purple Wheat	11.07
Blackberries, raw	90.49
Blueberries, raw	17.92
Apple juice, canned/bottled, unsweetened, without added Ascorbic acid	0.01
Apple, Fuji, raw, with skin	0.65

USDA: National Nutrient Database for Standard Reference, Release 24

Polyphenol content (mg/serving) of taro wine in comparison with other food items

Food Description (100g serving size)	Polyphenol content (mg/serving)
Taro Wine	118.5
Blackberry	8-27
Raspberry	6-10
Red wine	**20-35**
Tofu	8-70
Blueberry	200-220
Kiwi	60-100
Yellow onion	35-120
Tempeh	45-55

The American Journal of Clinical Nutrition (Manach et.al,2004)

Proximate Composition of Taro Wine (OSF1)

ANALYTE per 100g	Content
Moisture, g	71.3
Ash, g	0.3
Energy, kcal	**114**
Total Fat, g	0.0
Total Carbohydrate, g	**28.2**
Total Dietary Fiber, g	0.0
Protein, g	0.2

Energy content of taro wine in comparison with other food items

Food Source per 100g	Energy Content (kcal)
Corn, white steamed*	386
Bread*	195
Squash, cooked*	16
Rice, white, long-grain, regular, cooked**	130
Rice, white, glutinous, cooked**	97
Bread, Wheat**	266
Taro wine	114

**USDA: National Nutrient Database for Standard Reference, Release 24*
***USDA SR-21 (nutrientdataself.com)*

Consumer survey/Analyses

Market Inventory of Red Wines

- Prices (per bottle, approx, 750 ml):
  - Most Red wine ranges from Php 130.00-2,500.00
  - Taro wine – Php 390.00

- Alcohol content:
  - Most red wines ranges from 9% -14% alcohol by volume
  - Taro wine – approx. 6 – 13%

- Mostly imported from France, Italy, California, America, Spain, Chile, Australia, South Africa, Argentina, Israel and Portugal

Consumer Survey

Major influences of the buying decision

-Price

-Quality and product attributes

} All consumers

-Novelty of the product

-Social profile/history of the product

-Nutritional /health attributes of the product

} More affluent and relatively sophisticated consumers

Impact of the Study

- Demand of modern consumers for wine with health benefits (functional foods)

- Raw material demand increases –
  - Generate income for farmers
  - Utilization of uncultivated areas for raw material production/acrid taro variety
  - Less competition for the production of other products utilizing the acrid taro

Impact of the Study

- **Zero waste:**
  - **Fermented mash being used in food product development and organic fertilizers**
  - **Peels for composting/rice hulls as soil ameliorants**
- **Utilization of swampy areas for the production of acrid variety of taro**

Product for Commercialization

- **Availability of raw materials** at VSU
  - Taro: VG-9 variety at PhilRootcrops
  - Rice: Arabon variety at Plant Breeding Department, VSU
- **Availability of area for raw material**
  - production at the cooperator's site (3 has. as initial allotment)
  - Idle lands in taro-producing areas (Region 7, 8 and Caraga – poorest region)
- **Health claims in the product labels** with FNRI analyses
- **Variants to select** by modern consumers (low and high alcohol-containing wine)

Financial Indicator for Taro Wine Business

Financial Indicators	Value
Payback Period	2.76 years
Net Present Value	P 516,282.79
Internal Rate of Return	17.46%

Bottled Taro Wine in Technomart (VSU *Pasalubong* Center)

Bottles Used for Taro Wine


PHILIPPINES
God bless!