ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 17 No. 1
March 2017
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

*Afr. J. Food Agric. Nutr. Dev*. 2017; **17(1):** 11822-11831 **DOI: 10.18697/ajfand.77.15515**

# PRODUCTION OF GOOD QUALITY WINE FROM SINGLE AND MIXTURE OF FRUIT PEELS

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Volume 17 No. 1
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**ABSTRACT**

Processing fruits into juices and related products generates a lot of wastes in form of peels which cause disposal problems. This paper summarizes the outcomes of a study of an alternative utilization of these wastes into wine making that could tremendously minimize financial disposal requirements. Averagely, 80kg of peels yielded 180, 144 and 72 liters of wine from pineapple, mango-pineapple mix and mango peels, respectively. In this study, three products were formulated which involved mango peels, pineapple peels and a mixture of mango and pineapple peels in the ratio of 1:2.25, respectively. The effects of initial total soluble solids (24, 26 and 32$^{o}$Brix) on physical and sensory characteristics of musts and wines were examined. The results showed that during fermentation for 6 months the total soluble solids of all musts decreased to 10.1, 11.4 and 14.5$^{o}$Brix, respectively while the pH was decreased from 4.5 to 3.65-3.78. The resultant wines had significantly different alcohol content at $P < 0.05$ in the range of (12 - 18%) by the end of the ageing period. The results of sensory evaluation showed a significant difference in terms of aroma, mouth feel and acidity ratings ($P > 0.05$), while color, clarity, and alcohol strength were generally similar in all the three aged wines. Samples made from mango and pineapple peels mix showed the highest overall acceptance. It was also observed that whereas this wine was made from cheap and readily available raw materials, it can be sold at relatively lower prices hence offering a competitive advantage over other local producers and economic feasibility. The Food Technology and Business Incubation Center (FTBIC) should, therefore, now aim at scaling-up production of these wines for commercialization. In order to out-compete imported brands, applying attractive flavorings and colorants to the peel wine will help in promoting the wine over the imported brands. Farmers should also be advised to eliminate or reduce fungicide and herbicide utilizations during production of pineapples since the residual agro-chemicals may greatly affect the quality of the product from the peels

**Key words:** Mango, pineapple, fruit peels, wastes, wine, brix, alcohol, total soluble solutes

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## INTRODUCTION

Wine making is one of the most ancient technologies and is now one of the most commercially prosperous biotechnological processes. Even though the grapes are the main raw material used for the wine production, there is an increasing interest in the search for alternative indigenous fruits such as orange, apple, mango, and also palm sap that are cheap and readily available for wine making in such countries where grapes are not abundantly available [1].

In the processing of fruits, peel is a major by-product and represents a serious disposal problem. The use of fruit peels for the production of biogas and dietary fiber has been described; however, the studies on peels are scarce. Their use as animal feed is known, although they can also be used for obtaining more valuable products like good quality pectins [2, 3]. Fruit peels, mainly mango peels, are rich in dietary fiber, antioxidant phytochemicals such as carotenoids, polyphenols, anthocyanins, and volatile compounds [4]. It is a safe and inexpensive material, comprising of an interesting new support for cell immobilization for wine fermentation. The preparation of wine or any other beverage using cells entrapped in fruit peel has not been attempted yet, and it is a very attractive proposition because of its full compatibility in the wine production. In Uganda, however, wine processors have not endeavored to explore the opportunity of processing the products from peels alone.

Furthermore, there has been no information documented on the different fruit peel formulation, fermentation time, ageing time, color and flavor characteristic and degree of acceptability of the wine made from fruit peels.

The Food Technology and Business Incubation Center (FTBIC) of Makerere University recently acquired three fruit processing machines (citrus fruit extractor, poly fruit machine and mobile fruit processing unit) which generate about 6, 5.3 and 2.6 tonnes of peels per day, respectively. In these fruits, the discarded portion is very high for example Mango 30-50%, pineapple 40-50% and orange 30-50%) which result in a very good substrate for wine making.

Therefore, FTBIC undertook and funded this study with the aim of investigating the suitability of fruit peel wine production as an alternative way of utilizing these wastes. The overall objective of this study was to produce wine from pineapple and mango peels as an alternative use of wastes.

## MATERIALS AND METHODS

Peels from mangoes, pineapples and a mix of mango and pineapple (Fig. 1c&d) were used in the fermentation process. Each of the formulation was packed in 200 ltr plastic containers and covered (Fig. 1e). Each of the covers of the container was fitted with air locks which allowed escape of the fermentation gases while restricting contact of air from outside the container. The progress of the fermentation process was monitored every 2 months for 6 months and this coincided with the time of siphoning. After 6 months of fermentation, the wines were packaged in 300 ml bottles, labeled (Fig.1f) and placed in

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ISSN 1684 5374

crates (Fig 1h). The color, aroma, taste, pH, total soluble solutes (TSS) and alcohol content were determined and results are shown in Table 2.

The three wine samples were coded Mango/pineapple peels wine (627); Pineapple peel wine (642); Mango peels wine (636) and evaluated for acceptability by 18 trained judges using the Hedonic scale (1-9) as: 1-Dislike extremely, 2-Dislike very much, 3- Dislike moderately, 4-Dislike slightly, 5-Neither like nor dislike, 6- Like slightly, 7-Like moderately, 8-Like very much, and 9-Like extremely.

The data obtained was analyzed using the Statistical Package for Social Sciences (SPSS) Computer package; the means were separated as presented in Table 3.

**a) Raw materials: Pineapples**

**b) Raw materials: Mangoes**

**c) Pineapple peels**

**d) Mango peels**

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e) Fermentation vessels


f) Finished and packed products


g) Finished and packed products


h) Wine crates

**Figure 1: Production photos**

## DISCUSSION

### Changes in pH, alcohol content and total soluble solids (TSS) during fermentation

Table 2 presents changes in alcohol content, TSS and pH of three fruit peel wines (Mango, pineapple and mango-pineapple mixture) during the course of fermentation for 6 months at room temperature.

The results revealed that alcohol was produced rapidly within the first 2 months (12.0%), increased to 15.0% after 4 months and reached 18.0% after 6 months. By the end of fermentation, there was a significant difference ($P < 0.05$) in final alcohol content of three wine samples, ranging between 12 and 18% (Table 2).

The initial TSS of the musts was 24, 26 and 32°B for 636, 642 and 627 (Mango, pineapple and mango-pineapple peel wine mixture), respectively. The TSS after 2 months reduced to 14.0, 15.6 and 16.4°B for 636, 642 and 627 wines, respectively. The TSS of wines reduced further to 12.0, 13.5 and 15.9°B for 636, 642 and 627, respectively at the end of the fourth month. After 6 months, the TSS decreased to 10.1, 11.0 and 14.5°B for the

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same wines. The addition of sugar at the beginning of fermentation is necessary to provide suitable conditions for the growth of yeast and fermenting the sugar into ethanol. From the results in Table 2, a similar trend of reduction in TSS was observed in all samples in favor of ethanol formation.

Generally, about 95% of the total sugars in juice are metabolized by the starter into ethanol and $CO_2$ whereas the remaining sugar (5%) is converted to cellular material and other products such as glycerol [5].

All musts had similar initial pH values 4.5, which reduced to pH 3.65-3.78 at the end of fermentation (Table 2). The observed decline of pH value could be due to increased microbial activities which led to the production of $H^+$ ions and the formation of carbonic acid from the reaction of $CO_2$ and water [6].

These results are in agreement with Ifie *et al*. [7] who reported the decline in TSS and pH, and increase in the yield of alcohol during the fermentation of roselle wine. However, roselle wine had lower maximum ethanol production (9.6%), final TSS (4.8°B) and pH-value (3.09) than those of the current study. Grape wine prepared in the study by Bindon *et al*. [8] had alcohol content of 11.77 - 15.5% and pH of 3.46 - 3.62, not comparable with mango and pineapple wines. However, in their study almost all sugar was consumed during fermentation. The different results among studies could be due to the fact that the acidity and ethanol content of wine depend on several factors, including type of fruit, type of yeast used, initial TSS in must and methods of wine production [9].

**Sensory properties**

Table 3 summarizes the mean scores of sensory evaluation of mango peels, pineapple peels and mango-pineapple peel wines based on a 9-point hedonic scale, where 1 was "dislike extremely" and 9 was "like extremely". The findings indicated that the different initial TSS and fruit differences yielded wines with different sensory characteristics. Overall, pineapple wine was rated a higher color score than mango and mango-pineapple mixture wines. Mango peels wine had a higher clarity score than the other wines. However, mango-pineapple peels wine scored highest in terms of aroma, sweetness, mouth feel, alcohol strength, acidity and overall acceptability.

As compared among the three wine samples, no significant was found in terms of color, clarity, and alcohol strength, as the panelists scored them 6-7. Similarity in terms of color and clarity could be attributed to equal quantities of sugar and water used (Table 1). However, there was general significance difference in aroma, mouth feel and acidity ratings ($P < 0.05$) the score was also observed to be 6-7. These results could be attributed to differences in types of fruits used [9]. The highest scores of all attributes except color and aroma were seen in wine made with mango-pineapple peels. This could be due to the blending of the two fruit peels leading to good appearance and high sugar content, which may have affected the taste of the sample.

**Economic feasibility**

From the study, it was observed that wine could be produced from fruit peels and hence an alternative utilization of the wastes. It is also clear that production costs remained

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almost the same with wine produced from fruit pulp much as the peels require sugar amelioration to make-up for the sugar levels needed. The yield of the wine is as indicated in table 4. The fact that acceptable products have been developed, which have a cheap if not a free source of raw materials in form of peels which are a nuisance, the price of wine from such materials will be quite lower than that from local competitors especially with good marketing and consistence in quality produced, hence economic feasibility.

Also, with a relatively prolonged period of ageing time (that is to say a year or so) the quality of the wines will exceedingly beat that of the locally made wines. This is because their ageing period is generally shorter hence a reasonable difference in terms of quality.

## CONCLUSION

Based on the level of health-promoting compounds present in ripe fruits, the ability to support yeast growth and the high alcoholic content of the wine, mango and pineapple peels can be a promising raw material for production of wine. The sensory evaluation results showed that all wines had an acceptable color, clarity, aroma, sweetness, mouth feel, alcohol strength and acidity. Wine prepared from a combination of mango and pineapple peels showed the highest overall acceptability. The contents of alcohol and TSS of this wine sample were 18% and 14.5°B, respectively which was categorized as sweet wine and, therefore, sweet wines in Uganda are likely to have a bigger market than dry wines.

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**Table 1: Formulation for different fruit peel wine**

| Ingredients | Mango peels wine (636) | Pineapple peels wine (642) | Mango & pineapple wine (627) |
|---|---|---|---|
| Peels | 8kg | 6.5kg | p/apple: mango (2.25:1) |
| Sugar | 5.5kg | 5.5kg | 5.5kg |
| Water | 12kg | 12kg | 12kg |
| Yeast | 30g | 30g | 30g |
| Citric acid | 5g | 5g | 5g |
| Vitamin B tablets | 6 tabs | 6 tabs | 6 tabs |

**Table 2: Changes in the fruit peel wine during the fermentation process**

| Time (months) | 0 | 2 | 4 | 6 | 0 | 2 | 4 | 6 | 2 | 4 | 6 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Variable | pH | | | | TSS | | | | Alcohol content (%) | | |
| Mango peels wine (636) | 4.5 | 4.00 | 3.8 | 3.78 | 24 | 14.0 | 12.0 | 10.1 | 12 | 15 | 18 |
| Pineapple peel wine (642) | 4.5 | 4.10 | 3.75 | 3.65 | 26 | 15.6 | 13.5 | 11.0 | 12 | 15 | 18 |
| Mango/pineapple peels wine (627) | 4.5 | 4.12 | 3.69 | 3.67 | 32 | 16.4 | 15.9 | 14.5 | 12 | 15 | 18 |

**TSS**- Total soluble solutes

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**Table 3: Sensory Evaluation Results**

| Product | Color | Clarity | Aroma | Sweetness | Mouth feel | Alcohol strength | Acidity | Overall acceptability |
|---|---|---|---|---|---|---|---|---|
| Mango peels wine (636) | 6.44(1.69)$^{a}$ | 6.94(1.56)$^{b}$ | 6.39(1.69)$^{cd}$ | 5.11(1.71)$^{a}$ | 5.06(1.76)$^{a}$ | 6.50(1.20)$^{a}$ | 5.56(2.12)$^{a}$ | 5.94(1.54)$^{a}$ |
| Pineapple peel wine (642) | 6.56(1.58)$^{a}$ | 6.67(2.30)$^{b}$ | 5.89(1.97)$^{d}$ | 5.78(1.93)$^{b}$ | 5.61(2.09)$^{b}$ | 6.22(1.62)$^{a}$ | 5.94(1.69)$^{ab}$ | 6.29(1.72)$^{a}$ |
| Mango/pineapple peels wine (627) | 6.44(1.58)$^{a}$ | 6.33(2.25)$^{b}$ | 7.44(1.72)$^{c}$ | 7.72(1.67)$^{c}$ | 7.11(1.18)$^{c}$ | 6.94(1.28)$^{a}$ | 7.00(1.76)$^{b}$ | 7.53(1.01)$^{b}$ |

1. **Figures in the brackets are the std dev of the means**
2. **Figures with same superscripts down the column are not significantly different at (p>0.05)**

**Table 4: Wine yield from fruit peels**

| Product | Raw materials/kg | Finished products/liters |
|---|---|---|
| Mango peels | 65 | 72 |
| Pineapple peels | 80 | 180 |
| Pineapple: Mango | 60:22 | 144 |

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## REFERENCES


1. **Reddy LVA and OVS Reddy** Production and characterization of wine from mango fruit. *World Journal of Microbiology and Biotechnology* 2005; **21**: 1345.

2. **Pedroza-Islas R, Aguillar-Esperanza E and EJ Vernon-Carter** Obtaining pectins from solid wastes derived from mango (*Mangifera indica*) processing. AIChE Symposium, Ser. 1994; **300**: 36–41.

3. **Kumar YS, Varakumar S and OVS Reddy** Production and optimization of polygalacturonase from mango (*Mangifera indica* L.) peel using *Fusarium moniliforme* in solid state fermentation. *World Journal of Microbiology and Biotechnology* 2010; **21**:1345–1350.

4. **Ajila CM, Naidu KA, Bhat SG and UJSP Rao** Bioactive compounds and antioxidant potential of mango peel extract. *Food Chemistry* 2007; **105**: 982–988.

5. **Romano P, Paraggio M and L Turbanti** Stability in by product fermentation as a strain selection tool of *Saccharomyces cerevisiae* wine yeasts. *Journal of Applied Microbiology* 2005; **84**: 336–341.

6. **Jacques KA, Lyons TP and DR Kelisall** The alcohol text book. Nottingham: Nottingham University Press 2003.

7. **Ifie I, Olurin TO and JO Aina** Production and quality attributes of vegetable wine from *Hibiscus sabdariffa* Linn. *African Journal of Food Science* 2012; **6(7)**: 212–215.

8. **Bindon K, Varela C, Kennedy J, Holt H and M Herderich** Relationships between harvest time and wine composition in *Vitis vinifera* L. cv. Cabernet Sauvignon 1. Grape and wine chemistry. *Food Chemistry* 2013; **138:** 1696–1705.

9. **Joshi VK and SK Sherma** Effect of method of must preparation and initial sugar levels on quality of apricot wine. *Research and Industry* 1994; **39(12):** 255–257.