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Short communication

Process standardization and quality evaluation of wine from Cavendish banana (*Musa*, genome AAA) cv. Robusta

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ABSTRACT

An investigation was carried out to standardize the process and quality evaluation of dry wine from banana (*Musa* sp.) cv. Robusta. The yeast strains *Saccharomyces cerevisiae* UCD522 and *Saccharomyces fermentatii* UCD519 were found to be suitable starter culture strains for banana wine preparation. Use of unpasteurized juice diluted in 2:1 ratio as the fermentative substrate significantly improved the sensory quality of banana wine as compared to wines from pulp, pasteurized and natural juice. The standardized process resulted in wine with 11.67% alcohol, 0.75% total acidity and 0.04% volatile acidity.

Key words: Banana wine, *Saccharomyces,* antioxidants.

India is one of the major producers of bananas with a production of 28.45 million tonnes per annum (National Horticulture Board, 3), but with a significant post harvest loss. Robusta is a popular high yielding cultivar characterized by fairly acidic fruits with distinct aroma, high juice yield and total soluble solids of 21-23°Brix. Traditionally, 'Banana beer', a short shelf alcoholic beverage from Matooke bananas, is produced in African countries (Akubor *et al*., 1). Blended wine from pasteurized juice of banana variety Poovan and beetroot has been standardized (Anon., 4). Sensory and nutritive quality of fermented beverages depends on the fermentative strain, fermentative substrate and fermentation environment like temperature and oxygen availability (Amerine and Ough, 2). The present paper describes the identification of a good fermentative yeast strain and the ideal substrate material for preparation of a high quality wine from the banana cultivar Robusta.

The mature fruits of banana cv. Robusta were ripened by 100 ppm ethylene gas treatment for 24 h at 20°C and a relative humidity of 90%. The fruits were pulped, treated with Pectinase CCM plus (@ 0.3%) for 90 min. at 50°C, and the juice was extracted. In the experiment to identify the suitable yeast strain for the preparation of banana wine, fermentation of the pasteurized juice with 200 ppm potassium metabisulphite (KMS) and 0.03% diammonium phosphate (DAP), was carried out at 16°C in quadruplicates in glass containers of 3l capacity using the 24 h-old starter cultures of yeast strains, *viz*., *Saccharomyces cerevisiae* UCD522, MSU4, Dr. Alex and *S. fermentatii* UCD519. The fermented juice was siphoned off to new bottles, clarified using 0.008% bentonite, sulfited with 100 ppm KMS, bottled and stored at 10°C for two months for stabilization. In the experiments to study the effect of raw material on yield and quality of wine, fermentation of different substrates, *viz*., unpasteurized pulp, unpasteurized juice, unpasteurized juice diluted with water in 2:1 and 1:1 ratios and pasteurized juice was carried out using *S. cerevisiae* UCD522 . The total soluble solids were adjusted to 22°B and acidity to 0.7% with tartaric acid whereever required. The fermentation, clarification and storage for stabilization were carried out as mentioned earlier. The finished wines were analyzed for their characteristic composition *viz*., pH, acidity, alcohol content, residual sugars, volatile acidity, phenolics, flavonoids, radical scavenging activity, and ferric reducing antioxidant potential (FRAP) using standard procedures (Amerine and Ough, 2; Siddhuraju and Becker, 6). The banana wine samples were analyzed for their sensory acceptance using a nine point hedonic scale. The experimental design followed was completely randomized design (CRD) and the results of biochemical analysis were subjected to one way ANOVA for comparison of treatment means (Gomez and Gomez, 5).

At 16°C, *S. cerevisiae* UCD522, *S. cerevisiae* Dr.Alex and *S. fermentatii* UCD519 fermented juice to reach dryness on 9th day of fermentation, while *S. cerevisiae* MSU4 completed the fermentation in 11 days (Fig. 1). The yeast strains yielded alcohol levels ranging 10.56-11.90%, typical to dry wines. Residual sugars after fermentation was in the range of 650 to 726 mg/l in wines, the levels well below the sensory threshold level (Amerine and Ough, 2), and a feature of dry wines. Total acidity levels did not show significant variation in samples fermented with different

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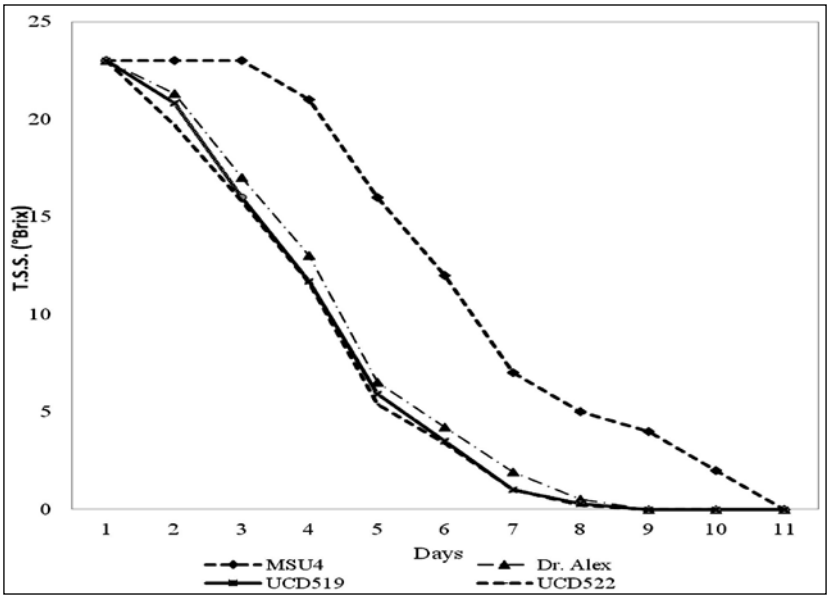

Fig. 1. Fermentation of banana juice by different *Saccharomyces* strains.

strains. However, volatile acidity of banana wine produced using *S. cerevisiae* Dr Alex was significantly higher than rest of the strains. The pH of the samples showed a trend similar to that of volatile acidity (Table 1). Sensory score of the wines on Hedonic scale did not exhibit significant variation. A good enological yeast initiates early fermentation even at high sugar levels, and ferment the juice to dryness with minimal production of volatile acids and H_2S. Acetic acid is a major flavour defect in wine causing vinuous odour (Amerine and Ough, 2). In the present study, a delay in the fermentation initiation was observed in juice samples inoculated with MSU4, and required two additional days for the completion of fermentation as compared to other strains. This represent a risk in quality of the finished product, as the contaminants if any, can take over the fermentation process. The banana wine fermented by the strain Dr Alex possessed high volatile acidity compared to all other wines. Based on the above criteria, *S. cerevisiae* strains UCD522 and *S. fermentatii* UCD519 were identified as the best starter cultures for banana wine production.

Sensory quality of banana wines prepared during the above experiment varied from 6.5-6.6 in a nine point hedonic scale (Table 1). The major defect noted by the judging panel was the cooked aroma of wine. Therefore, the second experiment on the enhancement of banana wine quality by standardization of substrate material for fermentation was conducted. *S. cerevisiae UCD522* strain was selected as the starter culture for this experiment based on the above results on its suitability in banana juice fermentation. This is a commercially available strain and is well known for complex aroma production in grape wines. The pH, acidity, alcohol, sugars and phenolics of all wines were characteristics to the standards of fruit wines. Significantly highest phenolics were observed in pulp fermented wine samples (701 µg/ ml). Dilution of banana juice in 1:1 ratio significantly reduced the total phenolics levels. Though pulp fermentation yielded wines with

Table 1. Physico chemical, nutritional and sensory characteristics of alcoholic beverage prepared from banana cv. Robusta fermented with different yeast strains.

Starter culture	pH	Total acidity (% tartaric acid)	Alcohol (%)	Sugars (mg/l)	Phenolics (mg/l)	Volatile acidity (% acetic acid)	Sensory score
S. cerevisiae UCD522	4.01	0.78	11.5	726	689	0.04	6.5
S. cerevisiae MSU 4	4.05	0.75	11.20	669	674	0.03	6.6
S. fermentatii UCD519	4.07	0.61	11.90	708	656	0.04	6.5
S. cerevisiae Dr Alex	3.88	0.71	10.56	650	670	0.07	6.5
$CD_{0.05}$	0.1	0.09	0.08	56	58	0.004	0.6

Table 2. Effect of substrate material on quality of alcoholic beverage prepared from banana cv. Robusta using the yeast *S. cerevisiae* UCD522.

Vinification substrate	pH	Total acidity[1]	Alcohol (%)	Sugar (mg/l)	Phenolics (mg/l)	Volatile acidity[2]	Flavonoids (mg/l)	Radical scavenging activity[3]	Total anti-oxidants[3]	Sensory attributes			
										Colour	Aroma	Taste	Overall
Unpasteurized juice	4.06	0.71	11.97	702	663	0.03	143	405	557	7.1	6.9	7.4	7.2
Pasteurized juice	3.98	0.72	12.33	653	629	0.02	143	247	592	7.2	5.9	6.3	6.6
Unpasteurized pulp	4.18	0.61	11.44	650	701	0.05	145	420	1058	7.1	4.8	6.1	6.7
2:1 diluted juice	4.07	0.75	11.67	702	629	0.04	104	374	326	7.0	7.5	7.9	7.75
1:1 diluted juice	3.68	0.74	10.76	645	525	0.02	69	94	185	6.9	6.5	6.8	6.9
$CD_{0.005}$	NS	0.05	0.05	NS	26	NS	24	25	56	NS	0.39	0.28	0.29

1 = % tartaric acid; 2 = % acetic acid; 3 = mg ascorbic acid equivalent antioxidant capacity per litre

significantly higher total antioxidant capacity, other nutritional parameters, *viz*., radical scavenging activity and flavonoids were on par with banana wine from unpasteurized juice. Pasteurization of juice resulted in a significant reduction of the total antioxidant capacity, radical scavenging activity and phenolics of the finished product (Table 2). In pulp fermented lots, increased time of contact between pulp, added pectinase and yeast enzymes would probably have lysed more cells, extracting higher quantities of the phenolics and antioxidants from the cells. Dilution of the juice reduced nutritional compounds such as phenolics, flavonoids, total antioxidant capacity and radical scavenging activity as compared to the unfermented juice, due to the obvious reason of dilution. The colour of banana wines prepared in the study varied from light to intense golden colour, but did not have an impact on the sensory appeal. The sensory ranking was low in terms of aroma and taste of the nutritionally rich, pulp fermented wine. The banana wine prepared by fermentation of 2:1 diluted juice possessed significantly superior sensory qualities compared to all other treatments.

It is concluded from present studies that *S. cerevisiae* UCD522 and *S. fermentatii* UCD519 are the most suitable yeast strains and unpasteurised juice diluted in the ratio 2:1 is the best fermentative substrate for banana wine preparation.

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