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Madhu D Nevase
College of Horticulture, Dr. B. S. K. K. V., Dapoli, Ratnagiri, Maharashtra, India

CD Pawar
College of Horticulture, Dr. B. S. K. K. V., Dapoli, Ratnagiri, Maharashtra, India

MH Khanvilkar
Directorate of Extension Education, Dr. B. S. K. K. V., Dapoli, Ratnagiri, Maharashtra, India

JJ Kadam
Department of Plant Pathology, College of Agriculture, Dapoli, Ratnagiri, Maharashtra, India

MC Kasture
Deputy Director of Research, Dr. B. S. K. K. V., Dapoli, Ratnagiri, Maharashtra, India

Corresponding Author:
Madhu D Nevase
College of Horticulture, Dr. B. S. K. K. V., Dapoli, Ratnagiri, Maharashtra, India

Standardization of blended wine from diluted juice of banana and kokum

Madhu D Nevase, CD Pawar, MH Khanvilkar, JJ Kadam and MC Kasture

Abstract
The experiment, was laid out in completely randomized design with six treatments of blending dilution juice of banana and kokum and four replications. In case of chemical composition of banana and kokum natural juice, the banana juice (fine pulp) recorded highest percentage of T.S.S., reducing sugars, total sugars with high pH and lower percentage of titratable acidity as compared to kokum juice. Kokum juice recorded 3731` mg/ 100g anthocyanin content. The must was prepared by diluting the blended juice in 1:0.5 proportion and T.S.S. was adjusted to 24^0Brix without adjusting pH. The titratable acidity of must was increased from T_1 to T_6 and pH showed decreasing trend. At the end of fermentation minimum T.S.S. was recorded by T_2 and T_5 followed by T_1 and T_3. The pH showed decreasing trend from T_1 to T_6 at the end of fermentation. Yeast count increased drastically on first day and maximum was recorded by T_1 followed by T_2 and T_3. Wine recovery increased from T_1 to T_6. In case of chemical composition of wine treatment T_4 recorded minimum T.S.S. at par with T_3. Treatment T_2 recorded minimum reducing and total sugars. The titaratable acidity and anthocyanin content increased from T_1 and T_6, whereas pH showed reverse trend. Highest alcohol percentage was recorded by treatment T_2 followed by T_3. Treatment T_3 recorded highest average sensory score followed by T_2. Maximum B:C ratio was recorded by treatment T_3 followed by T_2. Hence, among different treatments under study treatment T_3 (80% banana juice + 20% kokum juice) was found to be best followed by T_2 (90% banana juice + 10% kokum juice).

Keywords: Banana juice, kokum juice, blended wine, dilution

Introduction
Banana (*Musa acuminata*) is one of most important fruit crops, especially of the tropics. In banana production India rank 3rd in the world. Total area under banana is 0.75 lakh ha with 30.73 lakh MT production. Maharashtra rank first in banana export (1.11 lakh MT and value 339 crore). Banana has excellent dietary importance. It has a rare combination of energy value, tissue constructing elements, vitamin and minerals. It is rich in different minerals and components like β-carotene, vitamin B6, vitamin C and potassium. The use of banana observed beneficial in the treatment of several medical conditions such as intestinal disorders, constipation, arthritis, gout, anemia, allergies, kidney stones, tuberculosis and urinary disorders. An extensive range of products are prepared from banana. A few of the banana products highlighted are puree, juice, jam, RTS, flour, powder, vinegar, jelly, pectin and bread have wide commercialization. Wine is also prepared from banana fruits.
Kokum (*Garcinia indica* Choisy) is indigenous to the Western Ghats region of southern India and cultivated in Maharashtra, Goa, Gujarat, West Bengal, Assam and Karnataka with major area in Maharashtra. In Maharashtra it is cultivated on 1000 ha area with 4500 tones production and productivity is about 4.5 (T/ha). Kokum is an important spice which finds region in Ayurveda as therapeutic agent and it is effective against burns, piles, allergies, sunstroke, diarrhea, dysentery, tumors, cardiac diseases etc. An extensive range of product are prepared from kokum. A few of the kokum products are kokum squash, kokum powder, nectar, jam, pickle, RTS, syrup, dry rind (Amsul), Agal, kokum butter etc.
Blending is an art to develop different colours, aroma, astringency and taste of products to suit the consumers. Kokum fruit is difficult to consume without processing. Some part of total production is used for preparation of processed products and remaining part is not harvested and goes as waste. Therefore, it is great economic loss. The banana fruits are mostly used for fresh fruit market and processed products. It can be used to produce fermented beverages like wine.

By developing such technology postharvest losses in banana and kokum fruits can be reduced. This will also help to generate employment in addition to higher return to the farmers.

Material and Methods

The experiment, "Standardization of blended wine from diluted juice of banana and kokum " was laid out with seven treatments *viz.*, *viz.*, (T_1- (100% banana juice), T_2- (90% banana juice + 10% kokum juice), T_3- (80% banana juice+ 20% kokum juice), T_4- (70% banana juice+ 30% kokum juice), T_5- (60% banana juice+ 40% kokum juice) and T_6- (50% banana juice+ 50% kokum juice) and four replications in completely randomized design. For this study, Banana unripe fruits (Grand naine) were purchased from Central Experimental Station, Wakavali and after ripening fine pulp was prepared (fig 1). Well ripe, sound, healthy and disease free kokum fruits were collected from kokum tree present on educational farm of College of Horticulture, Dapoli. Well ripe, sound, healthy and disease free kokum fruits were washed thoroughly with running tap water and rinsed with distill water. The clear juice was obtained by decanting and used for preparation of wine (Fig. 2). The must was prepared by mixing the banana and kokum natural juice as per the treatment details and diluting it with distilled water in 1:0.5 proportion. 1kg of diluted juice was taken for each treatment. The T.S.S. of the juice of each treatment was adjusted to 24^0Brix by adding powdered sugar while, the pH was not adjusted. The prepared must was inoculated with yeast culture (*Saccharomyces cerevisiae* var. bayanus) and fermentation was allowed to continue till the must showed constant T.S.S. (Fig. 3). The prepared wine was analyzed for chemical composition and sensory characteristics.

Total soluble solids (T.S.S.) were determined with the help of Hand refractometer (Erma Japan, 0 to 32°Brix) and value was corrected at 20°C with the help of temperature correction chart (A.O.A.C., 1975) [4]. The pH of the wine was determined with the help of pH meter. (Model Systronics µ pH system 361). The titratable acidity (%), reducing sugars (%), total sugars (%), anthocyanin (mg/100 g) were estimated as per the methods suggested by Ranganna (1977) [15]. The alcohol (%) content in kokum wine was determined by the method as reported by Natu *et al.,* (1986) [10]. Sensory evaluation of wine was done by scoring wines numerically on a 20 point score card under six categories of sensory quality characteristics as per the method given by Ough and Baker (1961) [12]. Statistical analysis of the wine was carried out by standard method of analysis of variance described by Panse and Sukhatme (1995) [13].

Result and Discussion

The data regarding chemical composition of banana and kokum juice is given in Table 1. The banana and kokum juice used for must preparation contained T.S.S., reducing sugars, total sugars, titratable acidity and pH as 22 and 11°Brix, 6.17 and 4.80 per cent, 8.31 and 5.15 per cent, 0.63 and 5.05 per cent, 4.30 and 1.80 respectively. The anthocyanin content in kokum juice was 3731 mg/ 100g. Similar findings in chemical composition of banana fruits have been reported by Sankhe (2004) [17] during his studies on chemical composition of ripe fruit of banana and Nayak *et al.* (2010) [11] while studying on characterization of anthocyanin's from *Garcinia indica* Choisy. The data regarding chemical composition of must is presented in Table 2 Results were found to be non-significant with respect to T.S.S. In case of titratable acidity, the acidity was found to be increased from T_1 (0.47%) to T_6 (1.72%). The highest acidity recorded by T_6 was significantly superior over others. The increase in acidity from T_1 to T_6 may be due to increase in kokum juice percentage from T_1 (0.0%) to T_6 (50%). Similar findings have been recorded by Deshpande *et al.* (2020) [8] in blended must of grape, guava and noni juice. In case of pH results were found to be significant and pH was decreased from T_1 (4.32) to T_6 (2.54). Result analogous to present finding is also reported by Sadgir (2015) [16] in cashew apple and pineapple juice blended wine.

The data pertaining to the changes in T.S.S. during fermentation of must are presented in Table 3. The fermentation was found to be most active during first 3 days as indicated by a rapid fall in T.S.S. and it was terminated at 9th days as indicated by meager reduction in T.S.S. of the must. At the end of fermentation T.S.S. varied from 7.0^0Brix (T_2 and T_7) to 9.4^0Brix (T_4 and T_6). These results are in agreement with the result obtained by the Deshpande *et al.* (2020) [8] in must of blended wine of grape, guava and noni juice.

The pH of must was found to be slightly increased and then decreased on first day except T_1 during fermentation. From the pH value at the end of fermentation (9th day) it is seen that, pH was decreased from T_1 (3.88) to T_6 (2.50). This may be due to increase in kokum juice percentage in blended juice from T_1 (0.0%) to T_6 (50%). Result analogous to present finding was also reported by Sadgir (2015) [16] in must of cashew apple and pineapple blended wine.

The data regarding yeast count during fermentation are presented in Table 5. From this table it is seen that yeast count of each treatment increased rapidly on 1st day then slightly decreased on 2nd day of fermentation and later on number of colonies decreased drastically till the end of fermentation. From the yeast count data of 1st and 3rd day it is observed that, yeast count decreased from T_1 (3945 and 3598 × 10^4) to T_5 (1128 and 980 × 10^4) and slightly increased at T_6. Similar findings were observed by Chaudhary *et al.* (2014) [7] during preparation of wine by blending of grapes and jamun juice before fermentation.

The data regarding per cent wine recovery of banana and kokum blended wine is given in Table 6. The wine recovery was found to be increased from T_1 (79.55%) to T_6 (95.38%). This increase in wine recovery from T_1 (100% banana juice) to T_6 (50% banana + 50% kokum juice) may be the impact of kokum juice, which increased from 0 to 50 per cent from T_1 to T_6. These results are in agreement with the result obtained by Waradai (2014) [17] in banana based blended wine.

The data regarding chemical composition of wine is given in Table 7. In case of T.S.S., lowest T.S.S. (6.05^0Brix) was recorded by treatment T_4 (70% banana + 30% kokum juice) and it was at par with T_3 (6.21^0Brix) and significantly superior over others. However, increase in T.S.S. from T_5 (8.04^0B) to T_6 (8.24^0Brix) may be the effect of higher percentage of kokum juice in the blend (40 to 50%) which might have affected fermentation process. The highest T.S.S. recorded by treatment T_6 (8.24^0B) was significantly superior over rest of the treatments. The results of the present findings are supported by Deshpande *et al.* (2020) [8] in blended wine of grape, guava and noni juice. The reducing sugar content of wine decreased with increase in kokum juice percentage from treatment T_1 (0.31%) to T_2 (0.26%), then after increased from T_3 (0.30%) to T_6 (0.98%). The lowest reducing sugars (0.26%) recorded by treatment T_2 (90% banana + 10% kokum juice)

was significantly superior over rest of the treatments. The results of the present findings are supported by Deshpande *et al.* (2020) [8] in blended wine of grape, guava and noni juice. The total sugar content of wine showed same decreasing trend as that of reducing sugars with increase in kokum juice percentage from T_1 (0.45%) to T_2 (0.38%), then after increased from T_3 (0.52%) to T_6 (1.39%). The lowest total sugar content recorded by treatment T_2 was significantly superior over rest of the treatments. Beera *et al.* (2013) [6] reported similar results while studying wine from different varieties of mango. The titratable acidity ranged between 0.30 (T_1) and 1.34 per cent (T_6). The highest acidity recorded by treatment T_6 (50% banana + 50% kokum juice), was significantly superior over rest of the other treatments. The observations are in accordance with the findings of Balogun *et al.* (2017) in blended pineapple-carrot wine. The pH of wine showed decreasing trend with increase in kokum juice percentage from T_1 (0.0%) to T_6 (50.0%) in prepared must. Significantly lowest pH was recorded by T_6 (2.93). The results of the present findings are supported by Waradai (2014) [17] in banana based blended wine. Anthocyanin content of banana and kokum blended wine increased significantly from T_1 (0.0 mg/ 100gm) to T_6 (1063.05 mg/ 100gm) with increase in kokum juice percentage in prepared must from 0.0 per cent (T_1) to 50 per cent (T_6). Treatment T_6 (1063.05 mg/ 100gm) recorded highest anthocyanin content and it was significantly superior over others. Pawaskar (2016) [14] has reported similar results to the present findings in kokum wine. The alcohol content of wine increased from T_1 (8.21%) to T_2 (12.83%) and thereafter it decreased from T_3 (12.25%) to T_6 (10.59). Treatment T_2 recorded significantly highest alcohol content (12.83%) and treatment T_1 (8.21%) recorded lowest. The results of the present findings are supported by Attri *et al.* (2017) [3] while studying wine from ginger and different pear cultivar blended juice.

The wines prepared were evaluated for their sensory characteristics by a panel of 10 judges on 20 points score card. The mean scores are given in Table 8. The highest scores for colour and appearance (16), aroma (14), taste (13), astringency (13), overall acceptability (13) and overall quality (14) were recorded by treatment T_3. In case of body (14) highest score were recorded by treatment T_2. The highest overall quality score (average score) recorded by T_3 (14.0) was followed by T_2 (13.0). The findings were in accordance with the Sheshrao (2014) while preparation of blended wine by using guava, grape and noni juice.

The cost of production of wine prepared by diluting blended juice of banana and kokum is presented in Table 9. Cost of production of 180 ml wine in bottle was found lowest in T_6 (Rs. 22.53) and highest in T_1 (Rs. 33.37). Maximum sale price was recorded by treatment T_3 (Rs. 110/-) followed by T_2 (Rs. 100/-). Highest B:C ratio was recorded by treatment T_3 (4.39) followed by T_2 (3.98).

Table 1: Chemical composition of banana and kokum juice

Constituents	Banana juice	Kokum juice
Total soluble solids (°Brix)	22.00	11.00
Reducing sugars (%)	6.17	4.80
Total sugars (%)	8.31	5.15
Titratable acidity (%)	0.63	5.05
pH	4.30	1.80
Anthocyanin (mg/100gm)	-	3731

Table 2: Chemical composition of must prepared by dilution of blended juice of banana and kokum

Treatments	T.S.S. (°Brix)	Titratable acidity (%)	pH
T_1	24.32	0.47	4.32
T_2	24.05	0.76	3.79
T_3	24.02	1.03	3.25
T_4	23.96	1.27	2.96
T_5	24.05	1.54	2.73
T_6	23.99	1.72	2.54
S Em. ±	0.28	0.003	0.035
C. D. at 1%	NS	0.015	0.146

Table 3: Changes in T.S.S. (^{0}Brix) during fermentation of the must

Treatments	'0' day	1st day	3rd day	5th day	7th day	9th day
T_1	24	17.2	9	8	8	8
T_2	24	17	11	7	7	7
T_3	23.9	16	10.6	8	8	8
T_4	23.8	16.4	12	9.4	9.4	9.4
T_5	24	19	14	7	7	7
T_6	24	17	15	9.4	9.4	9.4

Table 4: Changes in pH during fermentation of the must

Treatments	'0' day	1st day	3rd day	5th day	7th day	9th day
T_1	4.32	4.26	4.20	4.00	3.94	3.88
T_2	3.65	3.67	3.60	3.53	3.39	3.30
T_3	3.25	3.38	3.34	3.30	3.18	3.13
T_4	2.95	3.10	3.05	3.02	2.99	2.88
T_5	2.73	2.89	2.86	2.84	2.7	2.69
T_6	2.55	2.69	2.67	2.63	2.55	2.50

Table 5: Changes in Yeast count during fermentation of the must

Treatments	Colony count in number × 10^4					
	'0' day	1st day	3rd day	5th day	7th day	9th day
T_1	0	3945	3598	196	92	32
T_2	0	3205	2028	139	81	43
T_3	0	2165	2009	98	75	23
T_4	0	1583	1450	102	72	53
T_5	0	1128	980	165	151	82
T_6	0	1894	1281	153	119	91

Table 6: Per cent wine recovery (%) of wine prepared by dilution of blended juice of banana and kokum

Treatments	T_1 (100:0)	T_2 (90:10)	T_3 (80:20)	T_4 (70:30)	T_5 (60:40)	T_6 (50:50)
Wine recovery (%)	79.55	84.10	85.50	87.70	93.45	95.38
S.Em. ±	0.31					
C. D. at 1%	1.27					

Table 7: Chemical composition of wine prepared by dilution of blended juice of banana and kokum (T.S.S., Reducing sugars, Total sugars, Titratable acidity, pH, Anthocyanin and Alcohol)

Treatments	T.S.S. (^{0}Brix)	Reducing sugars (%)	Total sugars (%)	Titratable acidity (%)	pH	Anthocyanin (mg/100gm)	Alcohol (%)
T_1	7.06	0.31	0.45	0.30	4.51	0	8.21
T_2	6.43	0.26	0.38	0.55	4.18	93.5	12.83
T_3	6.21	0.30	0.52	0.68	3.86	246.18	12.25
T_4	6.05	0.30	0.53	0.90	3.43	447.60	11.65
T_5	8.05	0.55	0.82	1.27	3.23	731.08	11.51
T_6	8.24	0.98	1.39	1.34	2.93	1063.05	10.59
S Em. ±	0.043	0.007	0.014	0.004	0.026	2.76	0.018
C D at 1%	0.178	0.028	0.058	0.014	0.105	11.04	0.072

Table 8: Sensory evaluation of wine prepared by dilution of blended juice of banana and kokum

Treatments	Colour & Appearance	Body	Aroma	Taste	Astringency	Overall Accept-ability	Overall quality (Avg. score)
T_1	12	12	13	12	12	12	12
T_2	14	14	13	12	12	12	13
T_3	16	13	14	13	13	13	14
T_4	15	13	12	11	11	11	12
T_5	13	9	9	8	8	8	9
T_6	12	8	8	7	7	7	8
Grape wine (Control)	18	14	15	13	15	15	15

Table 9: Cost of production of 1 lit. Wine prepared by blending natural juice of banana and kokum

Treatments	Cost of production of 1lit. wine (Rs.)	Cost of production of 180ml wine (Rs.)	Sale price/ 180ml bottle (Rs.)	B:C ratio
T_1	103.03	29.95	100	3.34
T_2	104.55	28.96	100	3.45
T_3	107.09	29.26	110	3.76
T_4	107.51	29.29	120	4.10
T_5	108.07	29.37	100	3.41
T_6	106.92	27.92	80	2.87

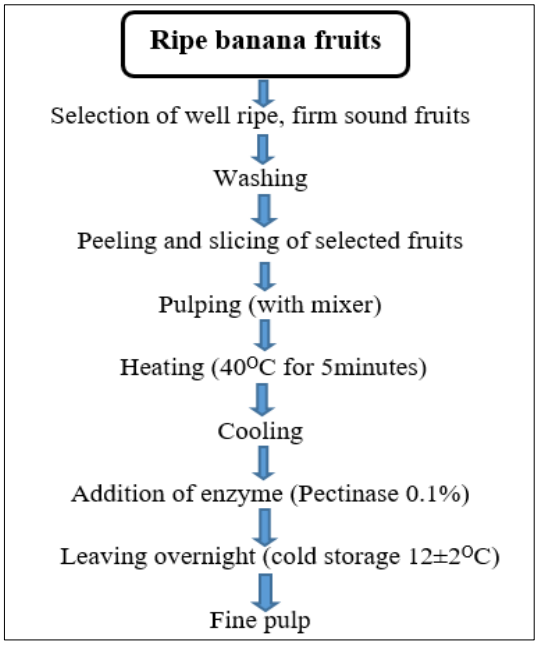

Fig 1: Preparation of fine pulp from banana fruits

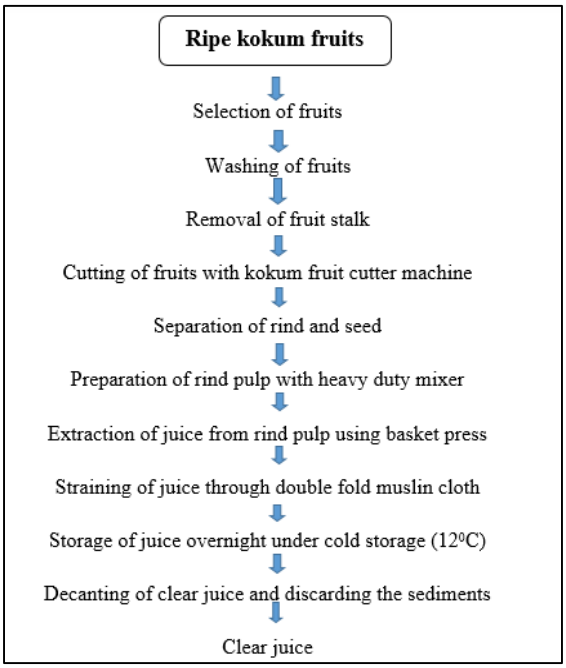

Fig 2: Extraction of juice from kokum fruits

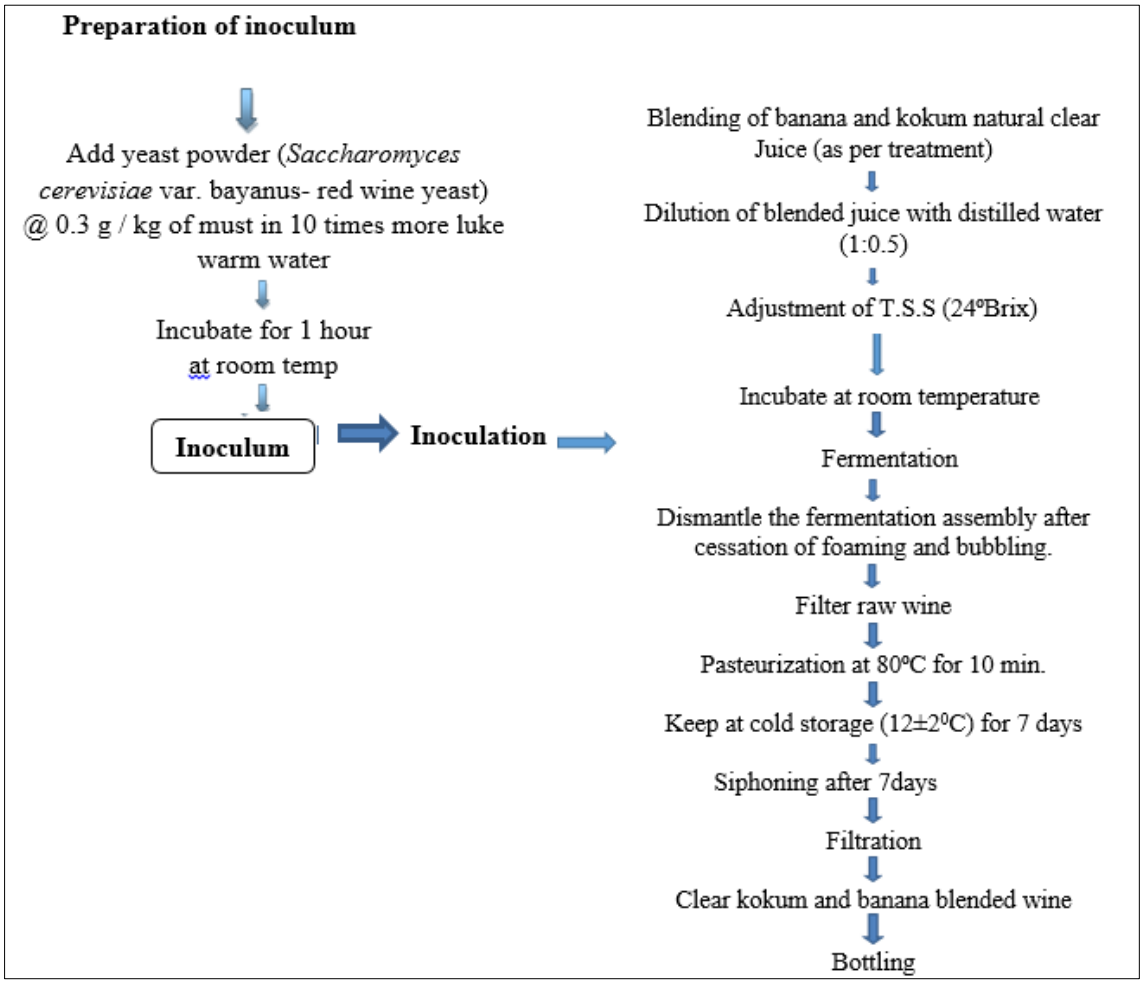

Fig 3: Preparation of wine from banana and kokum diluted juice

Conclusion

From experiment it can be concluded that best quality standard wine could be prepared from treatment T_3 (80% banana juice+ 20% kokum juice) followed by T_2 (90% banana juice+ 10% kokum juice) by adjusting T.S.S. of must to 24^0Brix and keeping pH of must natural.

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