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Effect of Blending Cashew Apple (*Anacardium occidentale* L.) and Aonla (*Emblica officinalis* Gaertn.) Juice on Fermentation of Wine

Apeksha B. Kamble [a*], C. D. Pawar [a++], M. H. Khanvilkar [b#], J. J. Kadam [c†] and M. C. Kasture [d†]

[a] College of Horticulture, Dr. B. S. K. K. V., Dapoli, Ratnagiri, Maharashtra, India.
[b] Directorate of Extention Education, Dr. B. S. K. K. V., Dapoli, Ratnagiri, Maharashtra, India
[c] Department of Plant Pathology, College of Agriculture, Dr. B. S. K. K. V., Dapoli, Ratnagiri, Maharashtra, India.
[d] Department of Soil Science and Agricultural Chemistry, College of Agriculture, Dr. B. S. K. K. V., Dapoli, Ratnagiri, Maharashtra, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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[++]Professor;
[#]Assistant professor;
[†]Associate Professor;
**Corresponding author: E-mail: apekshakamble2000@gmail.com;*

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ABSTRACT

A Completely Randomized Design (CRD) was employed to assess nine different treatment combinations, varying in juice ratios and fermentation conditions. The study aimed to evaluate the effects of blending cashew apple and aonla juices on the quality and fermentation characteristics of the resulting wine. While studying the chemical composition of cashew apple and aonla juice, cashew apple juice had a maximum value for T.S.S., reducing sugars, total sugars and pH. Aonla aonla juice had a maximum value for titratable acidity, ascorbic acid and tannin content. The T.S.S. of must was adjusted to 24 ºBrix and pH kept natural. The T.S.S. and pH was found to be decreased during fermentation of must. The treatment T_5 i.e. 60 % cashew apple: 40 % aonla juice (6.13 ºBrix) recorded lowest T.S.S. and T_9 i.e. 20 % cashew apple: 80 % aonla juice (10.53 ºBrix) recorded highest T.S.S. at 12th day of fermentation. The lowest pH recorded in treatment T_9 i.e. 20 % cashew apple: 80 % aonla juice (2.10) and highest recorded in T_1 i.e. 100 % cashew apple juice (3.38) at 12th day of fermentation. On the other hand, titratable acidity of must was found to be increased during fermentation of must. The minimum titratable acidity was found in treatment T_1 i.e. 100 % cashew apple juice (0.62 %) and maximum was recorded in T_9 i.e. 20 % cashew apple: 80 % aonla juice (1.74 %) at 12th day of fermentation. The yeast count increases rapidly until the 3rd day (1524 x 10^3) and after that yeast count subsequently declined until the fermentation reaches the 12th day (36.07 x 10^3), irrespective of treatments. At the end of fermentation (12th day) highest yeast count was recorded by treatment T_5 i.e. 60 % cashew apple: 40 % aonla juice (60 x 10^3) and lowest yeast count was recorded by treatment T_9 i.e. 20 % cashew apple: 80 % aonla juice (21 x10^3). Wine recovery from must ranged between 73.86 and 83.20 per cent. As a result, treatment T_5 (60 % cashew apple juice: 40 % aonla juice) showed better fermentation among all other treatments.

Keywords: Cashew apple juice; aonla juice; must; fermentation.

1. INTRODUCTION

Fermentation is a technique in development of new products with improved physicochemical and sensory qualities. It is comparatively efficient, low energy preservation technique which increases shelf life and decreases the need for refrigeration or other forms of food preservation methods [1]. Wine is a beverage resulting from fermentation of fruit juice by yeast with proper processing and additive. The cashew apple tree generally originated from Eastern Brazil and introduced by the Portuguese during the 16th century in India. Cashew (*Anacardium occidentale* L.) belongs to the family Anacardiaceae. The tree bears two forms of fruits, the 1st one is most important cashew nut (True fruit) and second one is cashew apple (Pseudo fruit). Cashew nuts are commercially put to use in India but cashew apples are rotten and wasted due to lack of proper preservation technique. “Feni” the alcoholic drink made in Indian state of Goa using discarded cashew apples. [2]. One of the important fruit crop in India is aonla having botanical name *Emblica officinalis* Gaertn. The fruit aonla commonly known as Indian Gooseberry. Aonla finds a special place in India due to its tremendous medicinal value. Aonla belongs to the family Euphorbiaceae. It is one of the richest source of vitamin C and tannin which is being used for preparation of various ayurvedic, unani system of medicine, pharmaceuticals, cosmetic and processing industry (Singh and Gaur, 2002). The aonla fruits, because of its high acidity and astringent taste, not palatable for direct consumption therefore it is mainly consumed only after processing. Wine from cashew apple juice can be good for health as it has good antioxidant activity and various studies reported that wine is healthy due to the presence of antioxidants in them. It is highly nutritive and one of the richest source of antioxidants, hence suitable for wine preparations. Due to its high acidity and astringent taste, aonla is primarily consumed after processing. Fermented fruit wines are famous throughout the world. In some regions it makes a significant contribution to the diet of millions of individuals. Different fruits might be used to produce highly palatable wines. As wine consist of both alcohol and antioxidants, hence it is unique among drinks. Drinking wine may have certain health benefits, including boosting heart, gut and brain health. Presence of high acidity in aonla and low in cashew apples they are used for blending in value addition. If blended wine is prepared from both these fruits, the prepared wine will be nutritionally rich and helpful for good health of peoples.

2. MATERIALS AND METHODS

The experiment “Studies on cashew apple (*Anacardium occidentale* L.) and aonla (*Emblica officinalis* Gaertn.) blended wine” ” was laid out in Completely Randomized Design with nine treatments viz. T_1 - (100% cashew apple juice), T_2 - (90% cashew apple juice + 10% aonla juice), T_3 - (80% cashew apple juice + 20% aonla juice), T_4 - (70% cashew apple juice + 30% aonla juice), T_5 - (60% cashew apple juice + 40% aonla juice), T6 - 50% cashew apple juice + 50% aonla juice), T7 - (40% cashew apple juice + 60% aonla juice), T8 - (30% cashew apple juice + 70% aonla juice), T9 – (20% cashew apple juice + 80% aonla juice) and three replication. For this investigation fruits of cashew apple and aonla were collected from the Central Experiment Station, Wakavali of Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth. Cashew apple juice extracted from helicoidal juice extractor machine. For extraction of juice from aonla fruit, the fruits were shredded with aonla shredder and then juice were extracted from shredded aonla with the help of basket press. Then prepared juice of both the fruits was blended as per treatment details and 1 kg of blended juice was taken. The T.S.S. of blended juice was adjusted to 24°B with the help of sugar. After adjustment of T.S.S., the pH of the juice was kept natural. The prepared must was inoculated with yeast culture (*Saccharomyces cerevisiae*) @ 0.3g/kg of must. For the activation of yeast these test tubes were kept at room temperature for 1 hour and then used for inoculation in must. After being inoculated with active yeast culture, the prepared must was kept for fermentation at room temperature. During fermentation, changes in T.S.S., titratable acidity and pH were recorded at alternate day. Yeast count recorded after 3 days interval during fermentation. At last per cent wine recovery were recorded. Total soluble solids (T.S.S.) were determined by using Hand refractometer (Erma Japan, 0 to 320B). Titratable acidity (%) and yeast count during fermentation were determined by using methods described by Ranganna [3]. Per cent wine recovery (%) were recorded on the basis of must weight.

3. RESULTS AND DISCUSSION

The data regarding chemical composition of cashew apple and aonla natural juice is presented in the Table 1. The cashew apple and aonla juice used for preparation of must contained T.S.S., reducing sugars, total sugar, pH, titratable acidity, ascorbic acid and tannins as 13.4 ºBrix and 10.8 ºBrix, 7.44 and 5.22 per cent, 10.36 and 7.08 per cent, 3.80 and 2.70, 0.37 and 2.37 per cent, 210 and 440 mg/100 ml and 1.70 and 2.29 per cent, respectively. Similar findings in chemical composition of cashew apple have been recorded by Damasceno et al. [4] and Anand et al. (2015). In case of aonla, similar results have been shown by Kulkarni et al. [5] and Singh et al. [6].

The T.S.S. of must of all the treatments were adjusted to 24 ºBrix. The titratable acidity of must was found to have increased from T_1 (0.33 %) to T_9 (1.09 %) may be due to an increase in aonla juice percentage from T_1 (0 %) to T_9 (80%). Similar results have been recorded by Sadgir [7] while working on cashew apple and pineapple blended wine. The pH of must decreased from T_1 (3.93) to T_9 (2.61) due to increase in acidity from T_1 (0.33 %) to T_9 (1.09 %). As acids are inversely proportional to pH. Nevase [8] found comparable outcomes when studying the process of producing wine using diluted banana and kokum juice.

The Table 3 shows that the must’s T.S.S. concentration gradually decreased until fermentation was finished. From the mean values of T.S.S. it is seen that T.S.S. decreased from 23.94 ºBrix (‘0’ day) to 7.60 ºBrix (12th day), irrespective of treatments. The maximum reduction in T.S.S. of must was recorded by T_5 (6.1 ºBrix) due to better fermentation. Due to conversion of sugar into alcohol the decrease in T.S.S. during the stages of fermentation is observed. The yeast converts sugars into alcohol. Similar results were obtained by Manor [9] while working on cashew apple wine and Suresh et al. [10] while working on aonla wine. The titratable acidity of the must increases continuously as the fermentation process carry on until it was finished. From mean values it is seen that titratable acidity increased from 0.69 per cent (‘0’ day) to 1.15 per cent (12th day), irrespective of treatments. The wine yeast can produce various acids during fermentation, this acid found to be responsible for noticeable titratable acidity increases during fermentation. The titratable acidity data indicates the increase in must acidity from T_1 (0.61 %) to T_9 (1.73 %) at the end of fermentation due to decrease in pH from T_1 (3.35) to T_9 (2.13). Acids are inversely proportional to pH. Similar results reported by Bhos [11] while working on cashew apple wine and Suresh et al. [10] while working on aonla fermented bevarages. The pH of must prepared by blending cashew apple and aonla natural

juice were not adjusted. The Table 4 shows that the pH of the must decreased continuously as the fermentation process went on until it was finished. From mean value it is seen that must pH decreased from 3.11 ('0' day) to 2.14 (12th day), irrespective of treatments. The reason behind decrease in pH of must may be the production of organic acids during fermentation. Because there is an inverse relation between acids and pH. Manor [9] also reported similar results while studying on cashew apple wine.

It is seen from Table 6, that yeast count increases rapidly until the 3rd day (1528 x 10^3) and after that yeast count subsequently declined until the fermentation reaches the 12th day (36.03 x 10^3). At 3rd day of fermentation highest yeast count was indicated by treatment T_5 (2146 x 10^3) and treatment T_9 (1069 x10^3) recorded lowest yeast count. At the end of fermentation (12th day), highest yeast count was recorded by treatment T_5 (63 x 10^3). Whereas lowest yeast count was recorded by treatment T_9 (24 x10^3). Similar results have been recorded by Manor [9] while working on cashew apple wine. The per cent wine recovery shows increasing trend from T_1 (73.81 %) to T_9 (83.24 %) due to increase in aonla juice percentage from (0) to (80 %). Pawar [12] also recorded similar results while working on sapota wine.

Table 1. Chemical composition of cashew apple and aonla natural juice

Sr. No.	Parameters	Cashew apple juice	Aonla juice
1	T.S.S. (° Brix)	13.4	10.8
2	Reducing sugars (%)	7.44	5.22
3	Total sugars (%)	10.36	7.08
4	Titratable acidity (%)	0.37	2.37
5	pH	3.80	2.70
6	Ascorbic acid (mg/ 100 ml)	210	440
7	Tannin (%)	1.70	2.29

Table 2. Chemical composition of must prepared by blending cashew apple and aonla natural juice

Treatments			T.S.S (º Brix)	Titratable acidity (%)	pH
	Cashew apple juice (%)	Aonla juice (%)			
T_1	100	0	24.00	0.33	3.93
T_2	90	10	24.13	0.39	3.57
T_3	80	20	23.93	0.48	3.43
T_4	70	30	24.00	0.54	3.20
T_5	60	40	24.00	0.74	3.04
T_6	50	50	23.86	0.77	2.93
T_7	40	60	23.93	0.81	2.84
T_8	30	70	23.93	1.01	2.77
T_9	20	80	23.93	1.09	2.61
Mean			23.97	0.68	3.14
S. Em (±)			0.06	0.01	0.01
C.D. at 1 %			NS	0.05	0.04

Table 3. Changes in T.S.S. (ºBrix) during fermentation of the must

Treatments	0 day	2nd day	4th day	6th day	8th day	10th day	12th day
T_1	24.00	14.60	10.66	9.20	8.06	8.00	8.00
T_2	24.13	13.33	8.60	7.93	7.74	7.00	7.00
T_3	23.86	13.66	10.06	9.00	7.93	7.80	7.80
T_4	24.00	12.78	8.20	7.31	6.68	6.53	6.53
T_5	24.00	12.60	7.91	7.06	6.20	6.13	6.13
T_6	23.86	13.00	8.60	7.73	6.93	6.93	6.93
T_7	23.93	13.86	9.53	8.06	7.20	7.20	7.20
T_8	23.93	14.80	12.00	10.40	9.20	9.20	9.20
T_9	23.93	15.93	12.93	11.06	10.55	10.53	10.53
Mean	**23.94**	**13.82**	**9.82**	**8.62**	**7.85**	**7.73**	**7.60**

Table 4. Changes in titratable acidity during fermentation of the must

Treatments	0 day	2nd day	4th day	6th day	8th day	10th day	12th day
T_1	0.30	0.35	0.50	0.56	0.57	0.57	0.61
T_2	0.36	0.41	0.66	0.75	0.78	0.78	0.82
T_3	0.45	0.54	0.77	0.83	0.85	0.86	0.90
T_4	0.48	0.63	0.93	0.98	1.00	1.02	1.06
T_5	0.70	0.76	1.06	1.10	1.12	1.12	1.16
T_6	0.74	0.86	1.12	1.16	1.21	1.23	1.27
T_7	0.77	0.92	1.32	1.37	1.38	1.41	1.45
T_8	0.98	1.02	1.46	1.52	1.53	1.56	1.58
T_9	1.03	1.14	1.58	1.64	1.65	1.70	1.73
Mean	**0.69**	**0.76**	**1.04**	**1.09**	**1.11**	**1.13**	**1.15**

Table 5. Changes in pH during fermentation of the must

Treatments	0 day	2nd day	4th day	6th day	8th day	10th day	12th day
T_1	3.97	3.94	3.79	3.63	3.42	3.39	3.35
T_2	3.54	3.41	3.30	3.23	3.19	3.13	3.10
T_3	3.39	3.26	3.14	3.06	3.00	2.94	2.91
T_4	3.17	3.00	2.91	2.89	2.87	2.81	2.77
T_5	3.01	2.86	2.77	2.75	2.72	2.68	2.63
T_6	2.90	2.81	2.72	2.68	2.61	2.56	2.51
T_7	2.80	2.68	2.56	2.54	2.49	2.45	2.41
T_8	2.73	2.60	2.51	2.46	2.40	2.35	2.32
T_9	2.64	2.51	2.46	2.39	2.30	2.19	2.13
Mean	**3.11**	**3.02**	**2.91**	**2.85**	**2.78**	**2.73**	**2.14**

Table 6. Changes in yeast count during the fermentation of the must

Treatments	Colony count in numbers x 10^3				
	0 day	3rd day	6th day	9th day	12th day
T_1	0	1287	671	230	26
T_2	0	1476	878	278	29
T_3	0	1337	732	244	30
T_4	0	2004	1289	254	55
T_5	0	2146	1475	564	63
T_6	0	1675	1015	331	46
T_7	0	1552	853	264	31
T_8	0	1186	587	180	25
T_9	0	1069	491	155	24
Mean	**0**	**1528**	**890**	**301.4**	**36.03**

Table 7. Per cent wine recovery from blended juice of cashew apple and aonla

Wine recovery (%)									
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)**	**T_7 (40:60)**	**T_8 (30:70)**	**T_9 (20:80)**
Mean	73.81	74.51	75.67	77.32	79.32	80.20	80.65	81.32	83.24
S. Em. (±)	0.94								
C.D. at 1%	3.91								

4. CONCLUSION

The findings suggest that a balanced blend of cashew apple and aonla juices can enhance the fermentation quality and nutritional profile of the wine, offering a novel approach to fruit wine production.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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