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Evaluation of the recipe for production of quality cider from Bael (*Aegle marmelos* Correa) fruit

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Abstract
Bael (*Aegle marmelos* Correa) is an indigenous fruit of India belongs to family Rutaceae. It is highly nutritious and therapeutically important. Narendra Bael-9 cultivar of Bael fruit was collected from bael orchard of university at main experiment station, Narendra Nagar (Kumarganj) during the peak season. Cider is a product of normal alcoholic fermentation of apple juice which contains more than 0.5 per cent alcohol but not more than 8.0 per cent. It has been observed that the raising of total soluble solid up to 20 oBrix, 0.35 to 0.45 per cent acidity, and 1:1, 1:2, and 1:3 pulp and water ratio were found ideal for bael cider. The evaluation of recipe indicated the possibility of production of quality cider from Bael fruit with high organoleptic score.

Keywords: Evaluation, recipe, production, Bael, *Aegle marmelos* Correa, Fruit

Introduction
Bael (*Aegle marmelos* Correa) is an indigenous fruit of India belongs to family Rutaceae and it is commonly known as Bengal quince, Indian quince, Golden apple, Holly Fruit, Bael, Belwa, Sriphal, Stone apple in India. This fruit is native to Northern India and, widely found through the Indian Peninsula [1]. Ripe bael fruit is one of the most nutritious fruit and therapeutically important, but it is not consumed in the fresh from due to various reasons. Therefore, it is generally used in the form of processed products like squash, juice, and dried powder. As bael fruit contains considerable amount of carbohydrates, so it can be utilizes for making cider. As compared to apple, it is richer in ascorbic acid (Vit C). The pH level (5.0 to 5.2) of bael fruit is also higher as compared to other fruit making it more suitable for yeast fermentation. In foreign, apple is generally used for cider preparation, however, little is known about the suitability of bael fruits for making cider.

The fruits are rich in carbohydrate and protein. It is investigated that the Narendra Bael-9 cultivar of bael fruit with an average weight 2090g and pulp, seed, fibre and shell percentage 65.23, 2.33, 4.49 and 27.39, respectively had a moisture content of 61.77%, total soluble solids 34.75%, acidity 0.35%, total sugars 19.44%, reducing sugars 3.87%, vitamin 'C' 17.25 mg/100gm and Total Phenols 2.42 mg/100ml [2]. In addition, it is rich in vitamin A (186 IU/100gm pulp); volatile oils and marmelosin [3].

Cider is a product of normal alcoholic fermentation of apple juice which contains more than 0.5 per cent alcohol but not more than 8.0 per cent4. It observed that the raising of total soluble solid up to 22 oBrix, 0.50 to 0.55 per cent acidity, and 3.05 to 3.20 pH with 100 ppm sulphur dioxide was found ideal for apple cider [5]. Cider vinegar is used for weak bones (osteoporosis), weight loss, leg cramps and pain, upset stomach, sore throats, sinus problems, high blood pressure, arthritis, to help rid the body of toxins, regulate blood pressure, reduce cholesterol and fight infection.

Materials and Methods
The present investigation entitled "Evaluation of the recipe for production of quality cider from Bael fruit (*Aegle marmelos* Correa)." was carried out in the lab of Department of Post-Harvest Technology, Collage of Horticulture and Forestry, Narendra Deva University of Agriculture and Technology, Narendra Nagar, Faizabad (U.P.) during the year 2015-16. The Bael fruits of Narendra Bael-9 cultivar were collected from Bael orchard of University at main experiment station of Department of Horticulture, Narendra Nagar (Kumarganj) during the year 2015. Therefore, the present investigations were undertaken to explore the evaluation of the recipe for production of quality cider from Bael fruit.

Formulation of recipe: Firm ripe fruits were washed breaking of shell, removal of pulp with seed and fibre. Bael pulp mixed with water (pulp: water ratio 1:1) and heating up to 80oC for one minute then passed through the pulper to obtain the pulp. The pulp obtained was homogenous and fibre free from seed and fibre.

After cooling, the whole pulp was divided into nine lots and transferred to clean and sterile jars and the acidity and T.S.S were adjusted, thereafter SO2 100 ppm was added in the form of K.M.S to avoid growth of wild yeast and bacterial contamination of the pulp. After half an hour, it was inoculated with a starter of *Saccharomyces cerviseae* Var. ellipsoids yeasts (5%). The mouth of jars were covered with cotton cloths and were kept for fermentation at ambient temperature (22oC to 28oC). Fermentation was measured by recording fall in the degree brix at 24 hrs interval till a constant value was attained. Thereafter, the must filtered through muslin cloth for discarding seed and pomace. Filtered juice was again kept for three weeks in container for fermentation.

After fermentation the clear fermented juice was siphoned off and filled into container up to brim and 50 ppm SO2 was added, sealed, air tight and kept at room temperature for maturation. In order to carry out racking for a period of six month (at an interval of two months) storage. After the maturation of cider fermented juice sealed in 200 ml bottles, pasteurized at 60 ^{0}C for 30 minute and storage at ambient temperature. Generally ciders are pasteurized at 82 ^{0}C to 88 ^{0}C for 1-2 minutes and then bottled.

TSS of bael cider was recorded by hand refractometer (0-32 scale). Acidity, vitamin C and browning content were estimated as per method of Rangana *et al.* [6] Alcohol content of cider was dete-rmined by Indian Standard Method No. 326, 1968. The estimation of total phenols was done by the method describe by Swane and Hills (1959) [7] with slight modification using Folin-Ciocalteau reagent. Reducing and total sugar were estimated by Fehling solution method given by Lane and Eynon (1923) [8]. The organoleptic evaluation for assessing the colour, flavour and texture of sample were conducted by a panel of 10 judges, who scored on 9 point Hedonic Scale (Amerine *et al*., 1965) [9] as given below:

Organoleptic score	Rating
9	Like extremely
8	Like very much
7	Like moderately
6	Like slightly
5	Neither like nor dislike
4	Dislike slightly
3	Dislike moderately
2	Dislike very much
1	Dislike extremely

The statistical analysis of the data was done by the method described by Panse and Sukhatme (1989) [10] using C.R.D experiment.

Treatments combination: One litre pulp was prepared by mixing calculated amount of pulp, sugar, citric acid and water as per specification. For formulation of recipe the total soluble solids and total acidity present in the pulp were first determined and then remaining amount of sugar and citric acid were adjusted as per treatment required (Table 1).

Results and Discussion

Fully ripe Bael fruits of cv. NB-9 having rich flavour and aroma was found ideal for preparation of bael cider. Diluted (1:1, 1:2 and 1:3) pulps with water were used as substrates for the preparation of cider from bael fruits. Data recorded on different parameters of bael cider prepared with application of different treatment combination at initial stage is presented in Table 2 The maximum TSS content 8.53 obrix was found in T6 followed by T9 and T3 treatments.

Table 1: Details of treatment combination for bael cider.

No. of Pulp:	T.S.S (%)	Acidity Treatments (%)	Water
T1	1:1	10	0.35
T2	1:1	15	0.35
T3	1:1	20	0.35
T4	1:2	10	0.40
T5	1:2	15	0.40
T6	1:2	20	0.40
T7	1:3	10	0.45
T8	1:3	15	0.45
T9	1:3	20	0.45

Cider prepared with 15 obrix TSS treatment combination reduced maximum TSS content followed by 20 obrix TSS treatment combination.

The maximum acidity content 0.97 per cent was found significantly in both T9 and T3 treatments. Cider prepared with 0.35 per cent and 0.45 per cent citric acid treatment combinations retained maximum citric acid content followed by 0.40 per cent treatment combination. However the minimum (0.70%) acidity was recorded in T1.

The maximum alcohol content 6.80 per cent was found significantly in T9 and T3 followed by T6 treatment combinations. Cider prepared with 20 per cent TSS treatment combination retained maximum alcohol content followed by 15 per cent TSS treatment combination. On the other hands T4 treatment combination found minimum (2.47 per cent) alcohol.

The maximum browning 0.24 per cent was found significantly in T3 followed by T2 and T8 treatment combinations. Cider prepared with 1:1. It is clear that vitamin 'C' content was found non-significantly higher in cider prepared with T3 treatment, i.e. 99.10 mg/100ml followed by T5 treatment (98.72 mg/100ml).

Reducing sugars, non-reducing sugar and total sugars were found non-significantly higher in T9 i.e. 9.76 per cent, 3.76 per cent and 13.51 followed by T6 i.e. 9.62 per cent 3.65 per cent and **13**.27 per cent respectively.

Data recorded on the organoleptic quality of bael cider result shows that the treatment T9 was found to be the best followed by T3 and T6 (Fig. 1). However, there was significantly difference between all treatments. The organoleptic score of treatment T9, T3 and T6 were like moderately. The score of 6.0 and above was rated acceptable.

It is evident from analysis of bael cider, the must having 0.35 to 0.45 per cent acidity and 20 per cent total soluble solids were found ideal. Therefore raising total soluble solids to 20oB made the cider highly acceptable. Further, the judges could concluded that the recipe containing 1:3 pulp and water ratio, 20 per cent T.S.S and 0.45 per cent acidity was found most suitable for cider making from Bael fruit with comparison to recipe containing 1:2 pulp and water ratio, 20

per cent T.S.S and 0.40 per cent acidity and recipe containing 1:1 pulp and water ratio, 20 per cent and 0.35 per cent acidity because it was retained maximum alcohol per cent, acidity per cent and found great acceptability with highest organoleptic score significantly maximum (0.46 mg/100ml) in T9 and T2 treatment combinations were found statistically at par with T8 treatment (0.45 mg/100ml). However the minimum (0.40 mg/100ml) total phenols was recorded in T6.

Table 2: Effect of different treatments on evaluation for production of good quality Bael cider at initial stage.

Treatments	T.S.S. oBrix	Acidity (%)	Alcohol (%)	Browning (%)	Total phenols (mg/100 ml)	Vitamin 'C' (mg/100 ml)	Reducing sugars (%)	Non- reducing Sugar (%)	Total sugars (%)
T1	5.00	0.70	2.81	0.21	0.43	98.60	9.33	3.33	12.66
T2	5.33	0.76	4.56	0.23	0.46	93.93	9.33	3.37	12.69
T3	8.07	0.97	6.80	0.24	0.43	99.10	9.33	3.33	12.67
T4	5.67	0.78	2.47	0.21	0.42	96.49	9.20	3.16	12.37
T5	4.93	0.74	5.74	0.21	0.43	98.72	9.20	3.22	12.42
T6	8.53	0.86	6.54	0.20	0.40	97.89	9.62	3.65	13.27
T7	5.07	0.89	2.81	0.22	0.42	97.81	9.16	3.16	12.32
T8	5.13	0.76	5.62	0.23	0.45	97.91	9.13	3.13	12.28
T9	8.07	0.97	6.80	0.21	0.46	98.27	9.76	3.76	13.51
C.D at 5%	0.27	0.02	0.93	0.01	0.02	NS	NS	NS	NS

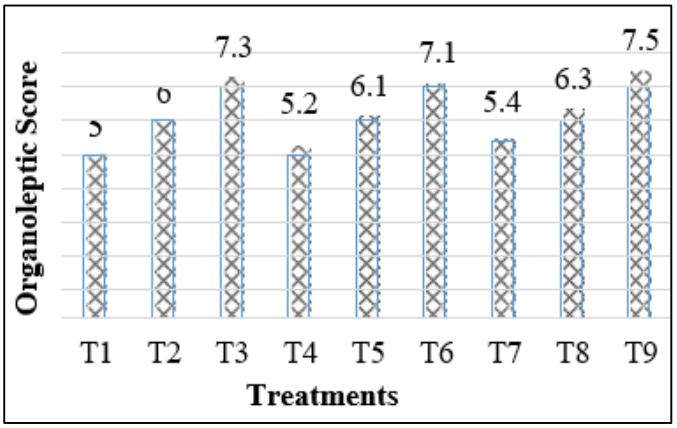

Fig 1: Effect of different treatments on organoleptic score of Bael cider at initial stage.

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