# Effect of Apple Varieties on Chemical and Sensory Properties of Cider 

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#### Abstract

The enhancement of TSS (Total Soluble Solids), alcohol content, and titrable acidity as measured by organoleptic evaluation of processed products were examined as effects of incorporation of cider at various concentrations. Additionally, the product's changes in physicochemical and organoleptic parameters were investigated while it was kept at room temperature and in a refrigerator. Golden delicious and Red delicious apple types were examined for making cider. Sugar was chosen for the creation of processed products because it is a rich source. Jam was created by mixing various amounts of apple juice with the other components. A semitrained panel evaluated the organoleptic quality of the processed product in order to assess consumer approval of various finger millet concentrations. Citric acid, sugar, and apple skin were added to make jam. Physical characteristics such as TSS, hue, thickness, etc. were assessed. Since the Red Delicious variety has a high sugar content, a high phenolic content, a high pH , and a low titrable acidity, it can be effectively substituted for improved cider production. True cider, defined primarily by the production process, can be as complex as a glass of wine and is served in Manhattans best restaurants as a perfect low-alcohol substitute for wine Prior(1920).


## Introduction

The apple tree, also known as Malus domestica or Malus pumila, is a deciduous tree in the rose family best known for producing the delicious, pomaceous fruit known as the apple. It is the most widely grown species in the genus Malus and is grown as a fruit tree all over the globe. China accounted for $48 \%$ of the total 84.6 million pounds of apples produced globally in 2014. The United States, Turkey, Poland, and Italy were other significant exporters, accounting for $6 \%$ or less of global production. (Feb, 2017). Apples contain a variety of phytochemicals, such as flavonoids (such as Catechins, Flavanols, and Quercetin) and other phenolic compounds (such as Epicatechin and Procyanidines), which are concentrated in the apple's skin, core, and pulp but have no proven health benefits for people. (Bayer et al., 2004).

One of the fruits that is most commonly consumed is the apple. As a source of monosaccharides, minerals, dietary fiber, and numerous biologically active compounds, including vitamin C and specific phenolic compounds that are known to function as natural antioxidants, apples play a significant role in the human diet. Additionally, some experts believe that polyphenols are antimutagenic and anticarcinogenic substances. (Lee and Mattick, 1989; Miller \& Rice-Evans, 1997).

## Method and Material

The current study's goal was to obtain apple fruit juice for use in producing cider and fruit juice from other fruits. The following is a discussion of the work's comprehensive description:

## Procurement of raw materials

The main ingredient used to make cider is apples. Apples that are suitable range in size from less than two inches in diameter to about eight inches. The quality of the apples used to make the final cider product determines almost all of its properties. These apples must be juicy, sweet, fully ripened, and have the right amount of natural acids and tannins to produce the best
cider. Two varieties of apple were taken i.e. Golden delicious and Red delicious apple from Shimla. The quantity of apples was 20 kg for Golden delicious and 10 kg for Red delicious apple.

Preparation of raw materials:
The cider making process typically involves following stages including Sweating, washing the fruit, grading and allowing for juice extraction:

Sweating: The optional mellowing period, the apples were stored in a clean, odour free area, mellow and soften for about a week to ten days before grinding. The apples were stored in pilot plant of Department of food technology at Akal college of agriculture, Baru sahib.

Washing: After the apples have mellowed, they were washed to remove leaves, twigs, insects, spray residues, and harmful bacteria. From there they were conveyed to a hopper filled with water.

Grading: For grading of apples different parameters are used: Shape, Size, Weight, Color Peel, Pulp.


Fig. 1 Extraction of juice by electric juicer


Fig. 2 Extraction of juice by hydraulic press

## Total soluble solids (TSS):

It is Number of solids dissolved within a Substance. It is commonly used to measure sugar content in drinks, medicines and fruits. Amount of solids dissolved. Its, Measuring is done a scale called Brix scale. The brix scale measures \% of total soluble solids in a substance (per 100 gram). This is measured using a refractometer and is referred to as the degrees Brix. , The Brix is usually considered equivalent to the percentage of sucrose (sugar) in the solution ( 60 degree Brix is equivalent to a sugar content of $60 \%$ ). The measurement must be made at 20degree brix to get accurate value.


Fig 3 Refractometer used to measure TSS
For cider making we require TSS 18 before fermentation and after fermentation it should be 5-6 and to maintain the TSS we add some extra sugar to maintain the TSS 18.

## Results

Table: 1 TSS of apple varieties

| Variety | TSS | Mixing of sugar $(\mathbf{g m} / \mathbf{l})$ |
| :---: | :---: | :---: |
| Red delicious | 12 | 4.8 |
| Golden delicious | 10 | 3.9 |

## Titrable acidity

The acid content of the must was determined by titrating a sample (a given volume) with a base such as sodium hydroxide solution to a phenolphthalein end point or alternatively, to a pH of 8.2. The titrable acidity is expressed as grams of tartaric acid per 100 ml .
TA as tartaric acid $(\mathrm{g} / 100 \mathrm{ml})=\frac{[(\mathrm{V})(\mathrm{N})(75)(100)]}{[(1000)(\mathrm{v})]}$
$\mathrm{V}=\mathrm{ml}$ of sodium hydroxide solution used for titration
$\mathrm{N}=$ Normality of sodium hydroxide solution
$\mathrm{v}=$ sample volume (ml)
If the above procedure is followed, the total titrable acidity can be calculated by multiplying the volume of 0.1 N NaOH used by a factor of 15 .
pH (potential of hydrogen)
pH in the juice of both varieties was measured by pH meter.


Fig 4 (a) pH meter (b) juice sample
10 ml of apple juice was taken. The neutral pH by dipping the pH rod into normal water was Maintained. The rod was dipped into sample. Readings of pH meter was measured. The PH shows the presence of acid in apple varieties.

## Total phenols content

The total phenolic content (TPC) was determined by spectrophotometry, using Gallic acid as a standard, according the method described by Singleton and Rossi (1965). Briefly, 0.2 mL of the diluted sample extract was transferred in tubes containing 1.0 mL of a $1 / 10$ dilution of Folin-Ciocalteu's reagent in water. After waiting for 10 minutes, 0.8 mL of a sodium carbonate solution ( $7.5 \% \mathrm{w} / \mathrm{v}$ ) was added to the sample. The tubes were then allowed to stand at room temperature for 30 min before absorbance at 743 nm was measured. The TPC was expressed as garlic acid equivalents (GAE) in $\mathrm{mg} / 100 \mathrm{~mL}$ of fruit juice. The concentration of polyphenols in samples was derived from a standard curve of gallic acid ranging from 0.2 to 4 $\mathrm{mg} / \mathrm{L}$.

## Ash content

The ash content of the juice sample was estimated according to the approved method of AOAC, (2000). For this test 10 ml of juice sample $\left(\mathrm{W}_{0}\right)$ was taken in a crucible of known weight $\left(\mathrm{W}_{1}\right)$ and then burned on the gas flame till fumes started disappearing. Then samples were placed in the muffle furnace at temperature of $550^{\circ} \mathrm{C}$. Then samples were transferred to the desiccators.

Then ash content was calculated as:
Here: $\mathrm{W}_{2}=$ weight after ashing
$\mathrm{W}_{0}=$ juice sample
$\mathrm{W}_{1}=$ weight before ashing

Ash (\%) $=\frac{W_{2}-W_{0}}{W_{1}-W_{0}} \times 100$
Total ash content in samples was determined as per the method described by Rangana (1986).

## Comparison:

Table 2: Comparison between TSS, TA, TSS/TA \& Total phenols

| Variety | TSS (\%) | TA (\%)1 | TSS/TA | Total phenols (mg GAE/L) |
| :--- | :---: | :---: | :---: | :---: |
| Red | 14.24 | 0.84 | 16.95 | 320.3 |
| Golden | 11.34 | 0.89 | 12.74 | 356.4 |



Fig 5: Comparison between TSS, TA, TSS/TA \& Total phenols

## Chemical properties of apple juices:

As a result, alcohol, including cider was consumed by worker and master alike, as the process of brewing produced a beverage that was bacteria free and therefore safe to drink(Watson 2008). The chemical composition of the two apple juices used for cider production. Cultivar juice (Red) had a slightly higher TSS/TA ratio and was perceived as a little more sweet than the 3-cultivar juice (Golden) (personal observation). Difference in appearance of the two juices was seen when visually assessed red apple juice contains more tannins. Tannins, the common name for procyanidines, are a group of polyphenols that bring bitterness and astringency to the cider (Lea et. al, 2003).

Table 3: Comparison between TSS, TA, TSS/TA \& Total phenols

| Varieties | TSS (\%) | TA (\%) | TSS/TA | Total phenols (mg GAE/L) |
| :---: | :---: | :---: | :---: | :---: |
| A | 9.6 | 0.61 | 15.8 | 325.6 |
| $\mathbf{B}$ | 10.4 | 0.56 | 18.8 | 358.4 |

The chemical composition of the two apple juices were analyzed for cider production. Cultivar juice (B) had a slightly higher TSS/TA ratio and was perceived as a little more sweet than the 3-cultivar juice (A) (personal observation). No difference in appearance of the two juices was seen when visually assessed:


Fig 6: Comparison between TSS, TA, TSS/TA \& Total phenols;
Now, it can easily be seen that there is a lot of scatters of the data points around this mean line. To evaluate the amount of scatter, we compute the standard deviation of the data in relation to the mean line, which turns out to be 0.17 in pH units. Then, if this data follows a normal distribution curve, we may be able to say that $95 \%$ of the data points should be within two
times the standard deviation from the mean line. The two red broken lines represent the mean plus or minus two times the standard deviation. Their equations are: Graph of pH in function of titrable acidity for 165 data points. $\mathrm{pHMIN}=3.96$ $\operatorname{Ln}(\mathrm{TA}) / \operatorname{Ln}(10) ; \mathrm{pHMAX}=4.64-\operatorname{Ln}(\mathrm{TA}) / \operatorname{Ln}(10)$ and the area between pHMIN and pHMAX is called the $95 \%$ confidence interval. And in effect, we can see that there are only a few data points outside this interval.


Fig 6: pHMIN and pHMAX
So, what this tells us is, if this data sample is truly representative, when we measure TA we could say that there is a probability of $95 \%$ that the pH would be between pHMIN and pHMAX , and there will be a difference of 0.68 in pH units between the two values. Unfortunately, in practice, this is not very useful because it could not help us in the dosage of the $\mathrm{SO}_{2}$ required to protect this cider. With our example and a pH of 3.11 (the MIN value), a very small dose of SO 2 is required, while at a pH of 3.79 , a dose near the maximum is required. The standard deviation is too large and in consequence the graph and equations cannot be used to dose the sulfite and skip the pH measurement.

Table 4: Result of coliform count of cider

| Sample | No. of colonies | Dilution factor | Volume | CFU |
| :---: | :---: | :---: | :---: | :---: |
| Golden delicious juice | Nil | $10^{-3}$ | 100 | Nil |
| Golden delicious juice | Nil | $10^{-5}$ | 100 | Nil |
| Red delicious juice | Nil | $10^{-3}$ | 100 | Nil |
| Red delicious juice | Nil | $10^{-5}$ | 100 | Nil |
| Red apple cider (Before heat treatment) | Nil | $10^{-5}$ | 100 | Nil |
| Golden apple cider (before $\mathrm{h} / \mathrm{t}$ ) | Nil | $10^{-5}$ | 100 | Nil |
| Golden apple cider(before $\mathrm{h} / \mathrm{t}$ ) | Nil | 10-3 | 100 | Nil |
| Golden apple cider(before $\mathrm{h} / \mathrm{t}$ ) | Nil | 10-5 | 100 | Nil |
| Red apple cider (After heat treatment) | Nil | 10-5 | 100 | Nil |
| Golden apple cider (After $\mathrm{h} / \mathrm{t}$ ) | Nil | 10-3 | 100 | Nil |
| Golden apple cider (After $\mathrm{h} / \mathrm{t}$ ) | Nil | 10-5 | 100 | Nil |
| Control cider | Nil | 10-5 | 100 | Nil |

Result (table 4.31) shows that CFU counting of golden delicious juice in $10-5$ dilution is $2 \times 10^{-7}$ or for $10^{-3}$ dilution it is 3 x $10^{-5}$ that shows no. of colonies 2 and 3 respectively in case of red delicious it is 3,2 for $10^{-3}, 10^{-5}$ dilution respectively overall it shows that n . of colonies in both variety is 2 . In case of cider, I have taken 7 samples those are red apple cider (before $\mathrm{h} / \mathrm{t}$ ), golden apple cider (before $\mathrm{h} / \mathrm{t}$ ), both wise taken in dilution of $10^{-3}$ and $10^{-5}$ which shows there were no number if colonies in both cider before heat treatment but in case of golden there was one colony in $10^{-3}$ dilution. In case of red apple cider, after heat treatment, there was no colony but one colony found in golden delicious. Overall result shows that red apple is better than golden.

## Conclusion

The present investigation entitled, "Effect of Apple Varieties on Chemical and Sensory Properties of Cider" was carried out in the laboratories of Department of Food Technology, Eternal University, Baru Sahib during 2016-17. The results obtained during the course of study are summarized below.

Two varieties of apple were evaluated (Golden delicious and Red delicious) for cider making. As it is a rich source sugar, was selected for development of processed product. Product i.e. jam was prepared by incorporation of different proportion of
apple juice with ingredients. Processed product was subjected to organoleptic evaluation by a semi-trained panel for judging the acceptance of different concentration of finger millet in processed product. Alcohol content of red delicious was 5.15 and golden delicious was 5.05. That shows red delicious contains more alcohol. Results of organoleptic evaluation show that the Red delicious variety was better than the Golden delicious.

Microbial testing Result (table 4.31) shows that cfu counting of golden delicious juice in $10-5$ dilution is $2 \times 10^{-7}$ or for 10-3 dilution it is $3 \times 10-5$ that shows no. of colonies 2 and 3 respectively in case of red delicious it is 3,2 for 10-3, 10-5 dilution respectively overall it shows that n . of colonies in both variety is 2 . In case of cider I have taken 7 samples those are red apple cider (before $\mathrm{h} / \mathrm{t}$ ), golden apple cider (before $\mathrm{h} / \mathrm{t}$ ), both were taken in dilution of $10-3$ and $10-5$ which shows there were no number if colonies in both cider before heat treatment but in case of golden there was one colony in 10-3 dilution. In case of red apple cider, after heat treatment, there was no colony but one colony found in golden delicious. Result of table 4.32 shows that in coliform count of both cider and juice no colonies were formed.

## References

Andrew GH Lea, Dri lleau JF, Michel A (2003) Possibilities for modelling cider fermentation. J Industries Agricoles et. Alimentaries 109 7-9.
Bayer C, Franza P,Mario R,Stahlb (2004) UV-C-inactivation of microorganisms in naturally cloudy apple juice using novel inactivation equipment based on Dean vortex technology, J.of Food Chemistry
Boyer J, Liu RH (2004), Health benefits of fruit and vegetables are from additive and synergistic combinations of phytochemicals. J. Nutrition Journal. 78 17S-520S.
Eberhardt, Marian V, ChangYong Lee, Liu RH (2000) J.Nature London 88 903-904. Nutrition: Antioxidant activity of fresh apples.
Goverd K, Beech FW (1979) Yeast problem in food and beverage industry, J.Food mycology.
Lee CY, Shallenberger RS, and. Vittum MT (1970).Free sugars in fruits and vegetables. J.Food Life Sci. Bull.
Mattick LR (1983). Criteria for determining the adulteration of apple juice and concen-trate N.Y. State. J Clin Nutr. Rep. 3 13-15.
Prior (1995) Situation and outlook report: Fruit and tree nuts.J. Of Food Microbiology 44 90-97.
Ribeiro, Flavia A, Gomes de Moura, Carolina F, Aguiar, Odair J, de Oliveira, Flavia Spadari, Regina CO, Nara R.,Oshima, Celina TR, Daniel A (2014) The chemo preventive activity of apple against carcinogenesis: antioxidant activity and cell cycle control, European Journal of Cancer Prevention September.
Watson B (2008) Cider hard \& sweet History, Tradition and Making Your Own. Library Of congress 3 411-422.
Wolfe K, Wu X, Liu RH (2003) ,Antioxidant Activity of Apple Peels, J. Agric. Food Chem. 51 609-614

