Studies on sensory and physico-chemical assessment of health benefits of pineapple jam prepared with different levels of dark chocolate and aloe vera

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Abstract
The present investigation is an attempt to formulate higher nutritional value of jam with added health benefit of aloe vera and value addition by dark chocolate with pineapple. Jam prepared by dark chocolate and pineapple is delicious and attractive product with some medicinal properties like anti-inflammatory, antimicrobial, antioxidant etc. It also helped in enhancing the nutritional quality and market value of the product. In the present study treatment T0, T1, T2 and T3 were formulated in which the pineapple jam was prepared by using pineapple (PA): Sugar(S) was in the ratio 70:30 and pineapple (PA): Dark Chocolate (DC): Aloe Vera (AV): Sugar(S) was in the ratio of (61:5:4:30, 56:10:4:30 and 51:15:4:30). It was found that T2 scored higher in sensory analysis of colour & appearance (8.4), body & texture (8.6), flavour & taste (8) and overall acceptability (8.11) and also considered as optimized product. The ash, acidity, ascorbic acidity, fat, moisture, protein, total solid, reducing sugar and total soluble solid percentage of T2 treatment was found to be 1.75, 1.36, 3.79, 3.65, 31.15, 1.32, 68.85, 7.87 and 40.86 respectively.

Keywords: Pineapple, jam, dark chocolate, aloe vera

1. Introduction
Agriculture production of India is varied with agro climatic conditions, so it can produce a wide variety of fruits and vegetables. Now, India is the second largest producer of fruits and vegetables after China sharing 10% and 13.28% respectively in world production. The major fruits grown in India include mango, banana, papaya, orange, mausambi, guava, apple, pineapple, sapota, berry, pomegranate, strawberry, litchi etc. (Anonymous, 2010) [1]. Rich diets in fruits are widely recommended for their health-promoting properties. Fruits have historically held a place in dietary guidance because of their concentrations of vitamins, like vitamins A and C, minerals, especially electrolytes; and more recently phytochemicals, especially antioxidants. Additionally, fruits and vegetables are recommended as a source of dietary fiber (Slavin and Lloyd, 2012) [20]. Interest in the nutritional value of fruits and vegetables has been increasing, in part because of recent findings on the high level of obesity and other diet-related health problems in children and in part because of increased federal support of programs funding consumption of fresh and processed fruit and vegetable products. (Barrett et al. 2007) [6].

1.1 Jam
Jams are basically prepared from fruits and various sugars that are made considerable mainly by heat treatment. There are different types of fruit jams like strawberry jam, mango jam, pineapple jam, apple jam, and mixed fruit jam (Patil et al. 2013) [23]. Jams are most popular fruit preserves is the product prepared from whole fruit, pieces of fruit, fruit pulp or fruit puree and with or without fruit juice. Fruit juice as optimal ingredients and mixed withcarbohydrate sweetener, with or without water and processed to a suitable consistency (Ranganna, 1977) [24]. Jam is semi-solid mass, which prepared from the cooking fruit pulp and sugar followed by acid, pectin, and flavors and colour substances. jams contains 68.5% total soluble substances and 45% fruit pulp (Codex, 2009) [13], while the revealed that jam should contain more than 65% total soluble solids (TSS) in finished product (Baker et al. 2001). Jam, jellies and marmalade is one simple fruit product prepared from fruit individually or combination of different fruit (Manay, and Shadaksharaswamy, 2005) [17].
1.2 Pineapple

Pineapples (*Ananas comosus*) is mostly grown in some tropical countries like India, Malaysia, Philippines and Thailand. Pineapple varieties are plentiful, but only a few types are sold commercially (Bartholomew *et al.*, 2003) [4]. Pineapple is a tropical plant with edible multiple fruits, is the most economically important plant. It has pleasant taste and flavor. Pineapple fruit is a good source of Bromelain, a digestive enzyme with biological functions i.e. a non-toxic compound and have a potential therapeutic application, including treatment of trauma, inflammation, autoimmune diseases, enhancement of immune response, and malignant disorders (Maurer, 2001 and Orsini, 2006) [18, 22]. Pineapple is low in calories, rich in vitamin C, B, and E. Also with minerals, dietary fiber, water etc., it is widely used in health food and fruit juicer Ministry of Health and Welfare, Taiwan (2015) [19].

1.3 Dark chocolate

Dark chocolate contains 50-90% cocoa solids, cocoa butter, and sugar, whereas milk chocolate contains 10-50% cocoa solids, cocoa butter, milk and sugar. Dark chocolate should not contain milk, there may be traces of milk from cross-contamination during processing, as the same machinery is often used to produce milk chocolate and dark chocolate. White chocolate does not contain any cocoa solids and is made simply of cocoa butter, sugar, and milk. Observational studies support the benefits of cocoa flavanols. The link between blood pressure and high cocoa intake was described in a study of the Kuna Indians, an isolated tribe who live on the Caribbean Coast of Panama (Hollenberg N K *et al.*, 2009) [13]. Main compounds of cocoa and chocolate which contribute to human health are polyphenols that act as antioxidants and have a potential anti-inflammatory, cardio protective, antibacterial, antiviral, antiallergenic, and anticarcinogenic properties. Cocoa is rich in plant chemicals called flavanols that may help to protect the heart problem. Flavanols have been shown to support the production of nitric oxide (NO) in the endothelium that helps to relax the blood vessels and improve blood flow, thereby lowering blood pressure. (Fisher *et al.*, 2003, Engler *et al.* 2004) [11, 9] Flavanols in chocolate can increase insulin sensitivity in short term studies; in the long run this could reduce risk of diabetes (Grassi *et al.*, 2012). Cocoa solids are intermediates of chocolate manufacturing, forming after cocoa butter extraction from the cocoa beans. Cocoa solids, called otherwise cocoa powder, confer a dark color to dark chocolate (Beckett, 2008) [3]. Most of the health benefits are attributable to the consumption of dark chocolate, while milk and white chocolate reportedly have no considerable beneficial impact on health (Beckett, 2008; Corti *et al.*, 2010; Verna, 2013) [8, 25].

1.4 Aloe Vera

Aloe vera, a well-known herbal plant has the potential to be the focal point for the yield of a functional beverage since it is known to offer protection from oxidative stress. The thick fleshy leaves of aloe plant contains not only cell wall carbohydrates such as cellulose and hemicellulloses but also storage carbohydrates such as acetylatedmannans (Ni *et al.*, 2004) [23]. Aloe vera products are among the most popular ones for the herbal products, medicine promoters, health issue and holistic healers. Today, the aloe vera industry is flourishing and the gel is used in many products such as fresh gel, juice and other formulations for health, medicinal and cosmetic purpose (Eshun and He 2004) [10]. Fruit and vegetable beverages have higher nutritional, medicinal and calorific values compared to synthetic beverages. Aloe vera has also been commonly used to treat burns, like sunburns and poison oak, poison ivy, and poison sumac infections and eczema (Mishra *et al.*, 2015) [20]. Aloe vera has the antibacterial property along with the anti-inflammatory property which helps to cure mouth and gum problems and severe gum diseases (Kumar *et al.*, 2010) [15].

1.5 Sugar

Sugar plays technological role in the traditional jam confection and it influences the soluble solids content thereby being essential for the physical, chemical and sensory properties of jams and also increasing its microbiological stability and safety (Basu and Shivhare 2010) [3]. Jam is prepared by boiling the fruit pulp with sugar to a thick consistency. It should not contain less than 68.5% total soluble solids (TSS). The essential constituents of a jam are pectin, sugar, acid and water, which are the must be present approximately in the following proportions: pectin 1%, sugar 50-75%, fruit acid 1% and water 33-38% (On fruit pulp basis) (Lal *et al.*, 1998) [16]. Jam is a fruit product. Jams are thick and sweet spreads made by cooking crushed or chopped fruits with sugar (Barbara H. Ingham 2010). Fresh mango contains a various type of nutrient but only vitamin C and folate are in significant amounts of the daily values as 44% and 11% respectively (Nutritiondata.com).

2. Materials and Methods

The experiment “Assessment of health benefits of Pineapple Jam prepared with different levels of Dark Chocolate and Aloe Vera” was carried out in the research lab of “Cyto Gene Research & Development” B – Block Chauraha, Indra Nagar, Lucknow, India – 226016

2.1 Raw material

Pineapple, Dark Chocolate, Sugar, Lemon Juice and Gelatin was procured from the local market Bhoothnath, Indra Nagar, Lucknow. All the chemicals used in the present study AR grade and LR grade.

![Fig 1: Flow diagram for preparation of Pineapple jam](image)
2.3 Sample preparation

\( T_0 \): Control prepared from pineapple (PA) and sugar (S) (70:30)

\( T_1 \): Experimental sample prepared from pineapple (PA), Dark Chocolate (DC), Aloe Vera (AV) and Sugar (S) (61:5:4:30)

\( T_2 \): Experimental sample prepared from pineapple (PA), Dark Chocolate (DC), Aloe Vera (AV) and Sugar (S) (56:10:4:30)

\( T_3 \): Experimental sample prepared from pineapple (PA), Dark Chocolate (DC), Aloe Vera (AV) and Sugar (S) (51:15:4:30)

2.4 Sensory analysis

The organoleptic attributes of the pineapple jam prepared by using pineapple, dark chocolate, aloe vera and sugar were studied by a panel of 8-trained panellists. The pineapple jam were assessed for its colour, flavour, taste, texture, mouth feel, aroma and overall acceptability on a 9-point hedonic scale.

2.5 Physico-chemical analysis

The pineapple jam samples of different treatments were analyzed for their different analytical methods. Moisture was determined by using official methods of AOAC (2000). Ash content was determined by using (AOAC method 900.02A). Fat content was determined by using (AOAC method 963.15). Protein percent was estimated by Kjeldahl method. Total carbohydrate percent was estimated by difference method. Reducing sugar content was determined by using (AOAC method 920.183) and T.S.S. content was determined by using IS 13815:1993/ISO 2173: 1978.

2.6 Statistical analysis

Data was analysed using Analysis of Variance (ANOVA) and Critical difference (C.D.) in WASP software and excel software. The significance were separated at p<0.05.

3. Result and Discussion

The data collected on the different aspects were tabulated and analyzed statistically using the method of analysis of variance and critical difference technique. The significant and non-significant differences observed have been analyzed critically within and between the treatment combinations.

The analyzed data is presented in this chapter under the following headings

1. Chemical characteristics
2. Organoleptic characteristics
3. Statistical characteristics

Table 1: Average data for different parameters of control and experiment (in percent)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Treatment</th>
<th>( T_0 )</th>
<th>( T_1 )</th>
<th>( T_2 )</th>
<th>( T_3 )</th>
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<tbody>
<tr>
<td>1. Physico-chemical analysis</td>
<td></td>
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<tr>
<td>Ash%</td>
<td></td>
<td>1.94</td>
<td>1.77</td>
<td>1.75</td>
<td>1.68</td>
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<tr>
<td>Acidity%</td>
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<td>1.36</td>
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<tr>
<td>Ascorbic Acid%</td>
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<td>4.34</td>
<td>3.79</td>
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<tr>
<td>Fat%</td>
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<td>0.46</td>
<td>1.87</td>
<td>3.65</td>
<td>4.95</td>
</tr>
<tr>
<td>Moisture%</td>
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<td>31.38</td>
<td>31.15</td>
<td>30.89</td>
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<tr>
<td>Protein%</td>
<td></td>
<td>0.89</td>
<td>1.07</td>
<td>1.32</td>
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<tr>
<td>Total solid%</td>
<td></td>
<td>67.48</td>
<td>68.62</td>
<td>68.85</td>
<td>69.11</td>
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<td>Reducing sugar%</td>
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<td>10.15</td>
<td>7.93</td>
<td>7.87</td>
<td>7.83</td>
</tr>
<tr>
<td>Total Soluble solid Brix.</td>
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<td>49.764</td>
<td>43.948</td>
<td>40.86</td>
<td>37.418</td>
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<td>2. Organoleptic Score (9-Point hedonic scale)</td>
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<tr>
<td>Colour &amp; Appearance</td>
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<td>7.8</td>
<td>8.4</td>
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<tr>
<td>Body &amp; Texture</td>
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<td>7</td>
<td>7.8</td>
<td>8.6</td>
<td>7.2</td>
</tr>
<tr>
<td>Flavour &amp; Taste</td>
<td></td>
<td>7</td>
<td>7.8</td>
<td>8</td>
<td>7.2</td>
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<tr>
<td>Overall acceptability</td>
<td></td>
<td>7</td>
<td>7.51</td>
<td>8.11</td>
<td>7.12</td>
</tr>
</tbody>
</table>

3.2 Physico-chemical characteristics of pineapple jam

3.2.1 Ash percentage

Ash percentage of different treatment combination of pineapple jam as determined by the method (AOAC method 900.02A). In the present study the mean ash value of pineapple jam was recorded of different treatments combination are T0 (1.94), T1 (1.776), T2 (1.75) and T3 (1.686), the highest mean Ash percentage was recorded in the sample of T0 (1.94) followed by T1 (1.77), T2 (1.75) and T3 (1.68). In most of the treatment combinations of ash percentage differed significantly (P<0.05).

![Fig 2: Average percentage of Ash in the samples of control and experimental samples.](image-url)
3.2.2 Acidity percentage
In the present study the mean acidity value of pineapple jam of different treatments were observed from treatment T0 (0.964), T1 (1.438), T2 (1.368) and T3 (1.302), the highest mean acidity percentage was recorded in the sample of T1 (1.438) followed by T2 (1.368), T3 (1.302) and T0 (0.964). The most of the treatment combinations of acidity content were significant.

![ACIDITY](image)

Fig 3: Average percentage of Acidity in the samples of control and experimental samples.

3.2.3 Ascorbic acid percentage
In the present study the mean ascorbic acid value of pineapple jam of different treatments were observed from treatment T0 (5.046), T1 (4.348), T2 (3.794) and T3 (3.076), the highest mean ascorbic acid percentage was recorded in the sample of T0 (5.046) followed by T1 (4.348), T2 (3.794) and T3 (3.076).

![ASCORBIC ACID](image)

Fig 4: Average percentage of Ascorbic acid in the samples of control and experimental samples.

3.2.4 Fat percentage
Fat percentage of different treatment combination of pineapple jam as determined by the method (AOAC Method 963.15). The mean fat value of pineapple jam of different treatments was T0 (0.464), T1 (1.872), T2 (3.65) and T3 (4.952), the highest mean fat percentage was recorded in the sample of T3 (4.952) followed by T2 (3.65), T2 (1.872) and T (0.464). The fat content of the pineapple jam were found to increase from T1 to T3.

![FAT](image)

Fig 5: Average percentage of Fat in the samples of control and experimental samples.

3.2.5 Moisture percentage
Moisture percentage of different treatment combination of pineapple jam as determined by the method (AOAC, 2000). The mean moisture value of pineapple jam of different treatments are T0 (32.52), T1 (31.38), T2 (31.15) and T3 (30.89), the highest mean moisture percentage was recorded in the sample of T0 (32.52) followed by T1 (31.38), T2 (31.14), T3 (30.83). The most of the treatment combinations of moisture content were significant (P<0.05).

![MOISTURE](image)

Fig 6: Average percentage of Moisture in the samples of control and experimental samples.

3.2.6 Protein percentage
Protein percentage of different treatment combination of pineapple jam as determined by the Kjeldahl method. The mean protein value of pineapple jam of different treatments are T0 (0.892), T1 (1.07), T2 (1.324) and T3 (1.642), the highest mean protein percentage was recorded in the sample of T3 (1.64) followed by T2 (1.32), T1 (1.07) and T0 (0.89).

The protein content of the pineapple jam were found to constantly increase from T1 to T3. The most of the treatment combinations of protein content were significant.
3.2.7 Total solid percentage
In the present study the mean total solid value of pineapple jam of different treatments were observed T0 (67.48), T1 (68.62), T2 (68.85) and T3 (69.11), the highest mean Total solid percentage was recorded in the sample of T3 (69.01) followed by T2 (68.85), T1 (68.62), T0 (67.48). The most of the treatment combinations of protein content deferred significantly.

3.2.8 Reducing sugar percentage
The mean reducing sugar value of pineapple jam of different treatments was T0 (10.15), T1 (7.932), T2 (7.87) and T3 (7.834), the highest mean reducing sugar percentage was recorded in the sample of T0 (10.15) followed by T1 (7.93), T2 (7.87), T3 (7.83). The reducing sugar content of the pineapple jam were found to decrease from T1 to T3. This shows that dark chocolate, sugar and aloe vera also helps in preparing a pineapple jam with lower reducing sugar content and helpful for health. The most of the treatment combinations of reducing sugar percentage were significantly.

3.2.9 T.S.S. percentage
T.S.S. percentage of different treatment combination of pineapple jam as determined by the method (AOAC, 1990). The mean T.S.S. value of pineapple jam of different treatments are T0 (49.764), T1 (43.948), T2 (40.86) and T3 (37.418), the highest mean T.S.S. percentage was recorded in the sample of T0 (49.76) followed by T1 (43.94), T2 (40.86), T3 (37.41). The T.S.S. content of the pineapple jam were found to decrease from T1 to T3. This shows that dark chocolate, sugar and aloe vera also helps in preparing a pineapple jam with lower T.S.S. content and helpful for health. The most of the treatment combinations of T.S.S. percentage differed significantly.
3.2.10 Body and texture percentage
The present study observed that the mean Body and texture value of pineapple jam of different treatments was T0 (7), T1 (7.8), T2 (8.6) and T3 (7.2), the highest mean body and texture was recorded in the sample of T2 (8.6) followed by T1 (7.8), T3 (7.2), T0 (7). The most of the treatment combinations of body and texture content were differed significant.

![Body and Texture Percentage](image)

**Fig 11:** Average percentage of Body and texture in the samples of control and experimental

3.2.11 Colour and appearance percentage
The mean colour and appearance value of pineapple jam of different treatments was T0 (6.8), T1 (7.8), T2 (8.4) and T3 (7.2), the highest mean colour and appearance was recorded in the sample of T2 (8.4) followed by T1 (7.8), T3 (7.2), T0 (6.8). The C.D. value at 5% Level 0.55 and the most of the treatment combinations of colour and appearance content were differed significant.

![Colour and Appearance Percentage](image)

**Fig 12:** Average percentage of Colour and appearance in the samples of control and experimental

3.2.12 Flavour and taste content
The mean flavour and taste value of pineapple jam of different treatments are T0 (7), T1 (7.8), T2 (8) and T3 (7.2), the highest mean flavour and taste was recorded in the sample of T2 (8) followed by T1 (7.8), T3 (7.2) and T0 (7). T2 treatments had higher value so this was the optimized product. The most of the treatment combinations of colour and appearance content were differed significant.

![Flavour and Taste Percentage](image)

**Fig 13:** Average percentage of Flavour and taste in the samples of control and experimental samples.

3.2.13 Overall acceptability content
The present study observed that the mean overall acceptability value of pineapple jam of different treatments was T0 (7), T1(7.51), T2(8.11) and T3(7.126), the highest mean flavour and taste was recorded in the sample of T2 (8.11) followed by T1 (7.51), T3(7.126) and T0 (7). The C.D. value at 5% Level 0.09 and the most of the treatment combinations of overall acceptability content were differed significant.

![Overall Acceptability Percentage](image)

**Fig 14:** Average content of Overall acceptability in the samples of control and experimental samples.

4. Summary and conclusion
Ash percentage in samples of different experimental treatments and control, the highest mean ash percentage was recorded in the sample of T0 (1.94) and lowest was recorded in T3 (1.68). Acidity percentage in samples of different experimental treatments and control, the highest mean ash percentage was recorded in the sample of T2 (1.43) and lowest was recorded in T1 (0.96). Ascorbic acid percentage in samples of different experimental treatments and control, the highest mean Ascorbic acid percentage was recorded in the sample of T0 (5.04) and lowest was recorded in T3 (3.07). Fat percentage in samples of different experimental treatments and control, the highest mean fat percentage was recorded in the sample of T1 (4.95) and lowest was recorded in T3 (2.07). Protein percentage in samples of different experimental treatments and control, the highest mean protein percentage was recorded in the sample of T3 (1.64) and lowest was recorded in T0 (0.89). Total solid percentage in samples of different experimental treatments and control, the highest
mean total solid percentage was recorded in the sample of T3 (69.11) and lowest was recorded in T0 (67.48). Reducing sugar percentage in samples of different experimental treatments and control, the highest mean Reducing sugar percentage was recorded in the sample of T0 (10.15) and lowest was recorded in T1 (7.83). Moisture percentage in samples of different experimental treatments and control, the highest mean Moisture percentage was recorded in the sample of T0 (32.52) and lowest was recorded in and T3 (30.89). Total Soluble Solid percentage in samples of different experimental treatments and control, the highest mean Total Soluble Solid percentage was recorded in the sample of T0 (49.76) and lowest was recorded in T1 (37.41). It may be concluded that the pineapple jam can be successfully prepared by supplementing pineapple, dark chocolate, aloe vera and sugar. Pineapple jam made with pineapple, dark chocolate, aloe vera and in treatment T2 was the best in organoleptic characteristics and received highest scored in organoleptic evaluation (Body & texture, colour & appearance, flavour & taste and overall acceptability).

5. References