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DEVELOPMENT OF MULBERRY-ALOE VERA BLENDED LEATHER AND ITS QUALITY EVALUATION DURING STORAGE

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ABSTRACT

The mulberry fruits were blended with aloe vera in different concentrations [T_1 (100:0:: Mulberry : Aloe Vera), T_2 (90:10:: Mulberry : Aloe Vera), T_3 (80:20:: Mulberry : Aloe Vera), T_4 (70:30:: Mulberry : Aloe Vera), T_5 (60:40:: Mulberry : Aloe Vera) and T_6 (50:50:: Mulberry : Aloe Vera)] for the preparation of leather. The developed value added blended leather packed in aluminium pouches then stored at ambient temperature for six months and subjected to physico-chemical characteristics at an interval of 2 months. During the study it was observed that blended leather retained maximum amounts total soluble solids (55.57 ^{o}Brix), titratable acidity (1.39%), ascorbic acid (7.89 mg/100 g), a* value (9.88) was recorded in T_1 (100:0:: Mulberry: Aloe Vera) where as the highest moisture content (18.55%), pH (4.26), L* value (28.99), b* value (5.21) was recorded in treatment T_6 (50:50:: Mulberry: Aloe Vera) in blended leather. An increasing trend was observed in a* value, pH and total soluble solids, but decreasing trend in L* value, b* value, titratable acidity and ascorbic acid during storage. Drying of fruits into leather will help to reduce the post harvest losses due to highly perishable nature of the mulberry fruits and could be recommended for large scale of production at industrial scale.

Keywords **:** Mulberry, Aloe vera, blended leather

Introduction

The intense coloured foods, fruits or vegetables are recognized as healthy foods for human body in most of the countries because they are rich in phenols, anthocyanins, carotenoids and flavonoids. The foods rich in phenolic compounds produces numerous health benefits primarily related to the hindrance of oxidative damage to cells (Bjorklund and Chirumbolo, 2017). Mulberry fruits are greatly consumed in different countries and have attained an important position in the food industry due to the occurrence of phenolic compounds including anthocyanins, phenolic acids and flavonoids. The major pigments responsible for colour in mulberry fruits are anthocyanins.

The ethno-botanical usage of mulberry involves the utilization of ripe fruits which are greatly valued for their delicious taste and are also consumed as fresh, dried or after extraction of juice. Mulberry fruits can be well exploited for preparation of numerous value added products, which are of commercial value from the industrial as well as health point of view. Thus, the mulberry-based products include juice (Wang *et al.*, 2017), liquor jam, muffin, marmalade, ice-cream, vinegar, wine *etc*., as well as other food and cosmetic products.

Aloe vera gel has a bitter taste due to the presence of aloin, which can be irritating when consumed raw; however, its palatability can be enhanced by adding other fruit juices (Sasikumar, 2015; Rahman *et al.,* 2024). Currently aloe vera juice is handy in the market to improve immune response in opposition to various ailments. Aloe vera gel or juice have various potential applications in the food industry as a preservative or functional ingredient and have also been supplemented to baked and dairy products, purees or fruit and vegetables juices and, in common, to foods that have sufficient consistency, such as jams or jellies and preparation of health drinks and other products (Ahlawat and Khatkar, 2011).

Fruit leather refers to fruit purees or a mixture of fruit juice concentrate and other ingredients which are cooked, dried on a non-sticky surface and rolled. A variety of fruits can be used to produce leathers. Fruit leathers are mainly eaten as snacks. They can however, also be made into beverages by blending with water or into sauces. This research work is aimed at production and evaluation of the physico-chemical analysis of blended fruit leather produced from mulberry fruits and aloe vera.

Material and Methods

The blended leather was prepared from different concentrations of mulberry-aloe vera blends i.e. 100:0, 90:10, 80:20, 70:30, 60:40 and 50:50, respectively as per the standard procedure given by Basha *et al.* (2018). Blended pulp and gel was heated along with desired quantities of sugar, citric acid and pectin with constant stirring on a uniform flame. The pulp/puree was spread on stainless steel trays smeared with oil. The pulp/puree was dried at 50 ºC for 7-10 hrs in cabinet tray drier. After that, the semi surface dried pulp sheets were cut into desired size usually of rectangular shape and again dried for 8-10 hrs. Then desired cutting was done and dried under fan for 2-3 hrs. The blended leather was stored in laminated pouches under ambient conditions (30-35 ºC) for a period of six months. The samples were analyzed periodically at an interval of 0, 2, 4 and 6 months of storages for chemical and organoleptic evaluation. The hunter colour values (L*, a* and b*) was measured using a colour analyser (Hunter Lab Color Flex Reston VA, USA). The moisture, TSS, titratable acidity, pH and ascorbic acid content were estimated as the standard procedure of AOAC (2012). The data obtained was statistically analyzed using CRD factorial for interpretation of results through analysis of variance (Gomez and Gomez, 1984).

Result and Discussion

Hunter colour values

Colour is a very important quality characteristic of fruit and vegetable products which influences the consumer acceptability. The hunter colour values of blended leather were measured in terms of L* (lightness), a* (redness/greenness) and b* (yellowness/ blueness). The effect of treatments and storage on hunter colour parameters (L*, a* and b*) are shown in tables (1, 2 and 3). On assessing the treatment means, the maximum mean L* value of 28.99 was recorded in treatment T_6 (50:50:: Mulberry: Aloe Vera) and the minimum mean L* value of 19.08 was recorded in T_1 (100:0:: Mulberry: Aloe Vera). The maximum mean a* value of 9.88 was recorded in T_1 (100:0:: Mulberry: Aloe Vera) and the minimum mean a* value of 5.24 was recorded in T_6 (50:50:: Mulberry: Aloe Vera). The maximum mean b* value of 5.21 was recorded in treatment T_6 (50:50:: Mulberry: Aloe Vera) and the minimum mean b* value of 0.83 was recorded in T_1 (100:0:: Mulberry: Aloe Vera). The significantly increasing trend in L* and b* values might be due to the addition of aloe vera which have more L* (Lightness) and b* (Yellowness) values. Patil *et al.* (2013) also found an increase in L* and b* values in guava jam blended with sapota. Due to the presence of mulberry pulp only, T_1 (100:0:: Mulberry: Aloe Vera) had maximum red colour component and thus showed highest a* (Redness) value and with incorporation of aloe vera it decreased.

Storage studies of blended leather revealed a significant decrease in mean L* and b* values from 25.42 to 22.82 and 4.20 to 1.94, respectively during six months of storage. It might be occurred probably due to oxidative and enzymatic reactions. However, a* value increased from 6.12 to 8.53 during storage. The decrease might be due to degradation of colour pigments with storage and formation of brown pigments (melanoidins) by maillard reaction that led to darkening of blended leather. During storage of pumpkin candy, Muzaffar *et al.* (2016) reported similar changes in L*, a* and b* values from 49.43 to 46.57, 7.19 to 8.7 and 16.2 to 12.25, respectively. They attributed this to occurrence of non-enzymatic browning that resulted in darkening of the product thus, decreased L* value. They further reported that degradation of carotene pigment also takes place during storage and thus was responsible for decrease in b* value. Similar results were also reported by Garg *et al.* (2018) in nutritionally enriched jam made from blends of Indian blackberry and other fruits.

Moisture

The mean moisture content of blended leather ranged from 14.81 to 18.55 per cent (Table 4) and varied significantly with varying levels of mulberry pulp and aloe vera. The significantly higher mean moisture content of 18.55 was observed in T_6 (50:50:: Mulberry : Aloe Vera) while as the lowest mean moisture content of 14.81 was recorded in T_1 (100:0:: Mulberry : Aloe Vera). It is evident from the results that there was a gradual increase in moisture content with the increasing concentration of aloe vera. The results are in close agreement with Patil *et al.* (2017) whom observed the increase in moisture content of date-mango leather with increasing concentration of mango pulp.

On assessing the storage means, the moisture mean of blended leather decreased significantly from highest mean value of 18.04 to lowest mean value of 15.49 during six months of storage. Decrease in moisture content might be due to evaporation of water from leather during storage. It might also be due to the leakage of packaging material that the fruit leather lost moisture during storage and utilization of free water in converting polysaccharides into monosaccharides and oligosaccharides. The moisture content of leather to a specific low level provides good conditions for the shelf life stability. Kaushal *et al*. (2017) also reported decrease in moisture content during storage in ginger plum leather and Gupta et al.2020 in osmo-dried peel sticks.

Total soluble solids

Different treatments and storage periods had significant impact on the total soluble solids of blended leather (Table 5). The highest treatment mean total soluble solids of 55.57 ^{o}Brix was found in T_1 (100:0:: Mulberry : Aloe Vera) and lowest of 50.98 ^{o}Brix was recorded in T_6 (50:50:: Mulberry : Aloe Vera).There was a significant increase in mean total soluble solids values with storage from 52.45 to 54.60 ^{o}Brix. The increase in total soluble solids might be due to conversion of insoluble polysaccharides into sugars. Similar findings as been reported by Kour *et al.* 2021.

Titratable Acidity

Different treatments had a significant effect on the titratable acidity of blended leather (Table 6). The mean titratable acidity was found to be significantly higher in T_1 (100:0:: Mulberry: Aloe Vera) as 1.39 per cent and lower as 0.91 per cent in T_6 (50:50:: Mulberry : Aloe Vera). The difference among treatments of blended leather might be due to the amount of citric acid and pulp used in preparation of blended leather.

Titratable acidity decreased from 1.20 to 1.11 per cent during storage of six months. The decrease in acidity might also be due to chemical interactions between organic constituents of the pulp induced by temperature and action of enzymes during storage. Higher acidity in fruit leather can prevent the growth of microorganisms and also helps in maintaining the colour and flavour of the fruit. Similar results were also recorded by Gupta (2019) in Karonda-beetroot RTS and leather and Kaushal *et al.* (2017) in appetizer ginger plum leather.

pH

The data in Table 7 revealed that on assessing the treatment means, the highest mean pH of 4.26 was observed in T_6 (50:50:: Mulberry : Aloe Vera) while as the lowest mean pH of 3.82 was recorded in T_1 (100:0:: Mulberry : Aloe Vera). There was a significant difference among the treatments with respect to pH which might be due to variation in composition of mulberry fruit and aloe vera.

On assessing the storage means, the pH mean of blended leather increased significantly from 3.92 to 4.14 during six months of storage. The changes in pH values might be due to decrease in acidity and also due to the other chemical that occur during storage interval. Similar results were also noticed by Sharma *et al*. (2013) in apricot fruit bar..

Ascorbic acid

The ascorbic acid values in Table 8 depicted that different treatments had significant effect on the ascorbic acid content of blended leather. Ascorbic acid, also known as vitamin C is one of the important nutritive components of human diet. Significantly higher ascorbic acid content of 7.89 mg/100 g was recorded in T_1 (100:0:: Mulberry: Aloe Vera) and lower ascorbic acid content of 4.25 mg/100 g was recorded in T_6 (50:50:: Mulberry: Aloe Vera). The declined trend with treatments might be due to the lower initial ascorbic acid content in the aloe vera, as compared to pure mulberry pulp.

Ascorbic acid is very sensitive to heat and oxidize quickly in presence of oxygen. There was a significant decrease in ascorbic acid content in blended leather from 7.92 mg/100 g to 4.71 mg/100 g during six months of storage. The decline in ascorbic acid might be due to oxidation of ascorbic acid to dehydro-ascorbic acid followed by further degradation to 2, 3-diketogluconic acid and finally to furfural compounds which enter browning reaction. Similar results were also reported by Hameed and Gupta (2021).

Conclusion

Therefore, development of blended value added leather by making a judicious combination of fruits and medicinal herbs having various therapeutic properties appears to be one of the best alternatives.

Table 1: Effect of treatments and storage period on L* value (lightness) of blended leather

Treatments	Storage period (Months)				
	0	2	4	6	Mean (Treatments)
T_1 (100:0:: Mulberry : Aloe Vera)	20.14	19.78	18.64	17.77	**19.08**
T_2 (90:10:: Mulberry : Aloe Vera)	22.89	21.94	21.03	20.51	**21.59**
T_3 (80:20:: Mulberry : Aloe Vera)	24.61	23.85	22.76	21.59	**23.20**
T_4 (70:30:: Mulberry : Aloe Vera)	26.27	25.63	24.78	23.94	**25.15**
T_5 (60:40:: Mulberry : Aloe Vera)	28.31	27.66	26.51	25.72	**27.05**
T_6 (50:50:: Mulberry : Aloe Vera)	30.31	29.64	28.60	27.41	**28.99**
Mean(Storage)	**25.42**	**24.75**	**23.72**	**22.82**	

Factors	**CD $_{(p=0.05)}$**
Treatment (T)	0.07
Storage (S)	0.05
T x S	0.14

Table 2: Effect of treatments and storage period on a* value (redness) of blended leather

Treatments	Storage period (Months)				
	0	2	4	6	Mean (Treatments)
T_1 (100:0:: Mulberry : Aloe Vera)	8.85	9.72	10.06	10.89	**9.88**
T_2 (90:10:: Mulberry : Aloe Vera)	7.16	8.42	9.51	10.41	**8.87**
T_3 (80:20:: Mulberry : Aloe Vera)	6.43	7.31	7.96	7.96	**7.41**
T_4 (70:30:: Mulberry : Aloe Vera)	5.55	6.46	7.18	7.54	**6.68**
T_5 (60:40:: Mulberry : Aloe Vera)	4.78	5.71	6.28	7.54	**6.07**
T_6 (50:50:: Mulberry : Aloe Vera)	3.96	4.42	5.76	6.84	**5.24**
Mean(Storage)	**6.12**	**7.01**	**7.79**	**8.53**	

Factors	**CD $_{(p=0.05)}$**
Treatment (T)	0.10
Storage (S)	0.08
T x S	0.21

Table 3: Effect of treatments and storage period on b* value (yellowness) of blended leather

Treatments	Storage period (Months)				
	0	2	4	6	Mean (Treatments)
T_1 (100:0:: Mulberry : Aloe Vera)	1.52	1.01	0.68	0.11	**0.83**
T_2 (90:10:: Mulberry : Aloe Vera)	2.80	1.98	1.13	0.79	**1.68**
T_3 (80:20:: Mulberry : Aloe Vera)	3.64	2.74	1.98	1.05	**2.35**
T_4 (70:30:: Mulberry : Aloe Vera)	4.84	3.86	2.89	2.02	**3.41**
T_5 (60:40:: Mulberry : Aloe Vera)	5.72	4.79	4.31	3.62	**4.61**
T_6 (50:50:: Mulberry : Aloe Vera)	6.64	5.54	4.63	4.02	**5.21**
Mean(Storage)	**4.20**	**3.32**	**2.60**	**1.94**	

Factors	**CD $_{(p=0.05)}$**
Treatment (T)	0.06
Storage (S)	0.05
T x S	0.12

Table 4: Effect of treatments and storage period on moisture (%) of blended leather

Treatments	Storage period (Months)				
	0	**2**	**4**	**6**	**Mean (Treatments)**
T_1 (100:0:: Mulberry : Aloe Vera)	16.14	15.56	14.34	13.23	**14.81**
T_2 (90:10:: Mulberry : Aloe Vera)	16.98	15.85	14.65	13.96	**15.36**
T_3 (80:20:: Mulberry : Aloe Vera)	17.64	16.92	16.01	15.78	**16.58**
T_4 (70:30:: Mulberry : Aloe Vera)	18.35	17.74	16.96	16.02	**17.27**
T_5 (60:40:: Mulberry : Aloe Vera)	19.12	18.64	17.99	16.70	**18.11**
T_6 (50:50:: Mulberry : Aloe Vera)	19.99	18.95	18.03	17.26	**18.55**
Mean(Storage)	**18.04**	**17.27**	**16.33**	**15.49**	

Factors	**CD $_{(p=0.05)}$**
Treatment(T)	0.07
Storage (S)	0.06
T x S	0.14

Table 5: Effect of treatments and storage period on total soluble solids (^{o}Brix) of blended leather

Treatments	Storage period (Months)				
	0	**2**	**4**	**6**	**Mean (Treatments)**
T_1 (100:0:: Mulberry : Aloe Vera)	54.76	55.01	55.86	56.65	**55.57**
T_2 (90:10:: Mulberry : Aloe Vera)	53.88	54.71	55.61	55 .98	**54.89**
T_3 (80:20:: Mulberry : Aloe Vera)	52.79	53.30	53.98	54.64	**53.67**
T_4 (70:30:: Mulberry : Aloe Vera)	51.96.	52.74	53.20	53.96	**53.30**
T_5 (60:40:: Mulberry : Aloe Vera)	50.89	51.63	52.42	53.61	**52.14**
T_6 (50:50:: Mulberry : Aloe Vera)	49.94	50.78	51.21	51.99	**50.98**
Mean (Storage)	**52.45**	**53.03**	**53.71**	**54.60**	

Factors	**CD $_{(p=0.05)}$**
Treatment (T)	0.07
Storage (S)	0.05
T x S	0.14

Table 6: Effect of treatments and storage period on titratable acidity (%) of blended leather

Treatments	Storage period (Months)				
	0	**2**	**4**	**6**	**Mean (Treatments)**
T_1 (100:0:: Mulberry : Aloe Vera)	1.46	1.41	1.35	1.30	**1.39**
T_2 (90:10:: Mulberry : Aloe Vera)	1.37	1.31	1.26	1.21	**1.33**
T_3 (80:20:: Mulberry : Aloe Vera)	1.28	1.22	1.17	1.12	**1.22**
T_4 (70:30:: Mulberry : Aloe Vera)	1.19	1.14	1.10	1.06	**1.13**
T_5 (60:40:: Mulberry : Aloe Vera)	1.09	1.03	0.99	0.95	**1.04**
T_6 (50:50:: Mulberry : Aloe Vera)	0.98	0.93	0.89	0.84	**0.91**
Mean(Storage)	**1.20**	**1.22**	**1.15**	**1.11**	

Factors	**CD $_{(p=0.05)}$**
Treatment (T)	0.06
Storage (S)	0.05
T x S	N.S

Table 7: Effect of treatments and storage period on pH of blended leather

Treatments	Storage period (Months)				
	0	2	4	6	Mean (Treatments)
T_1 (100:0:: Mulberry : Aloe Vera)	3.76	3.80	3.84	3.89	**3.82**
T_2 (90:10:: Mulberry : Aloe Vera)	3.87	3.92	3.98	4.03	**3.84**
T_3 (80:20:: Mulberry : Aloe Vera)	3.94	3.98	4.03	4.09	**4.01**
T_4 (70:30:: Mulberry : Aloe Vera)	4.07	4.12	4.16	4.22	**4.15**
T_5 (60:40:: Mulberry : Aloe Vera)	4.14	4.19	4.23	4.29	**4.20**
T_6 (50:50:: Mulberry : Aloe Vera)	4.20	4.25	4.29	4.34	**4.26**
Mean (Storage)	**3.92**	**4.04**	**4.08**	**4.14**	

Factors	**CD $_{(p=0.05)}$**
Treatment (T)	0.12
Storage (S)	0.10
T x S	N.S

Table 8: Effect of treatments and storage period on ascorbic acid (mg/100 g) of blended leather

Treatments	Storage period (Months)				
	0	2	4	6	Mean (Treatments)
T_1 (100:0:: Mulberry : Aloe Vera)	9.91	8.01	7.21	6.44	**7.89**
T_2 (90:10:: Mulberry : Aloe Vera)	9.10	7.24	6.71	5.88	**7.23**
T_3 (80:20:: Mulberry : Aloe Vera)	8.32	7.00	6.11	5.23	**6.66**
T_4 (70:30:: Mulberry : Aloe Vera)	7.54	6.34	5.57	4.64	**6.02**
T_5 (60:40:: Mulberry : Aloe Vera)	6.75	5.77	4.74	3.58	**5.21**
T_6 (50:50:: Mulberry : Aloe Vera)	5.91	4.87	3.68	2.54	**4.25**
Mean(Storage)	**7.92**	**6.54**	**5.67**	**4.71**	

Factors	**CD $_{(p=0.05)}$**
Treatment (T)	0.05
Storage (S)	0.04
T x S	0.10

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