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PREPARATION AND PHYSIOCHEMICAL EVALUATION OF PAPAYA-SOY FRUIT LEATHER

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Abstract

The research was aimed to prepare soy slurry fortified papaya leather. Papaya pulp and soy slurry were mixed with the proportion as sample A (100:0), B (90:10), C (80:20) and D (70:30) respectively. The mixture was dried in cabinet dryer for 7 hours at 80 °C temperature until the thickness reached 5 mm. The chemical analysis of papaya fruit leather had reducing sugar %, vitamin C (mg/100 g), acidity (%), carotenoid (mg/100 g) of 39.46±0.77, 54.00±1.72, 0.87±0.05, 1.21±0.15 respectively. In case of papaya-soy fruit leather the highest values for reducing sugar %, vitamin C (mg/100 g), acidity %, carotenoid (mg/100 g) was 30.76±1.55 in sample B, 56.01±1.15 in sample D, 0.79±0.05 in sample B, 1.01±0.03 in sample B respectively. Sample B (90:10) was preferred by sensory evaluation. Fortification of soy slurry can be done in other fruit leather also.

Keywords: *Papaya, soy slurry, fruit leather, vitamin c, carotenoid*

Introduction

Papaya (*Carica papaya* L.) is a commercial fruit crop in many tropical regions of the world. The fruit is a rich source of vitamins, minerals and dietary antioxidants, short postharvest life and susceptibilities to physical damage, water loss, chilling injury, diseases, and insect pests are the major postharvest constraints for papaya fruit (Singh 2011). Soybeans (*Glycine max* L.) is an abundant, economic source of protein. (Anderson *et al*. 1995). Legumes are inexpensive, nutrient-dense sources of protein that can substitute dietary animal protein (Anderson *et al*. 1999). Not only are legumes excellent sources of essential minerals, but they are also rich in dietary fiber and other phytochemicals that may affect health. Fortification of food is of current interest because of nutritional awareness of consumers (Sastry and Tummuru 1985). Supplementation with legumes is one way to meet the needs for protein foods. Fruit leathers are dried sheets of fruit pulp which have a soft, rubbery texture and a sweet taste. Fruit leathers are eaten as snack foods instead of boiled sweets. They are also used as ingredients in the manufacture of cookies, cakes and ice cream. The preservation of fruit leathers depends on their low moisture content, the natural acidity of the fruit and the high sugar content. When properly dried and packaged, fruit leathers have a shelf life of up to 9 months (FAO 2009).

Fruit pulp-based fruit leathers are nutritious and organoleptically acceptable to customers. They contain substantial quantities of dietary fibers, carbohydrates, minerals, vitamins and antioxidants. About 25 to 30% produce of fruits and vegetables are wasted due to inadequate facilities of processing, preservation, storage, handling and transportation (Neelesh *et al*. 2014). The perishable nature of highly nutritious papaya has made it limited in use and short shelf life has made it seasonal. It is sensitive to deterioration even when stored under refrigerated condition. Processing of papaya into fruit leather can be considered as one of the methods for preservation. Consumption of fruit leather can be economic as well as convenient value-added substitute for natural fruits as a source of various nutritional elements. Making of fruit leathers help top preserve food by drying and, hence, controlling postharvest spoilage. Making fruit leather from ripe or slightly over-ripe fruit which is not suitable for fresh consumption will enable producers to satisfy market demand during off season periods.

This research attempt to utilize soy slurry, to increase total solids of fruit leather which reduces the drying time. Furthermore, soybean contains high protein. Germination is necessary to soften the kernel structure of soybean, reduce the anti-nutritional factors and improve nutrient content. The objective of this research was to observe the effect of fortification of soy slurry on quality of papaya leather.

Materials and Methods

Firstly papaya was bought from Kathmandu, Nepal. Other raw materials were bought from local shop in Kathmandu, Nepal.

Preparation of papaya pulp

Fully ripe papaya was brought and washed with clean water. It was peeled manually and cut around 3x3x3 cm^3 for pulping. The cut pieces were grinded in mixer and papaya pulp was prepared.

Preparation of soy slurry

Soybeans were brought and were soaked overnight in a room temperature 27 °C 70 % RH. Excess water was drained. Now, the soybean were spread on tray and covered with wet muslin cloth and left for 3 days for sprouting at room temperature. Then, sprouted soybeans were dried and powder was obtained by grinding in a mixer. Finally, 1 part of powder and 5 part of water were mixed to prepare soy slurry.

Preparation of papaya-soy fruit leather

Papaya pulp and soy slurry were mixed in different ratios as given below. Papaya pulp alone served as a control. The papaya pulp and soy slurry were mixed in a ratio A (100:0), B (90:10), C (80:20) and D (70:30). The TSS of mixture was raised to 30 °Bx by addition of sugar amount - 86.25 g (A), 89.63 g (B), 93 (C) and 96.4 g (D) and then spread over almunium trays) and dried in a cabinet drier for 7 hours at 80 °C temperature until the thickness reached 5 mm. Now each papaya soy fruit leather were cut in an appropriate size and then packed in an air tight plastic bag separately and stored in cool and dry place until further analysis.

Chemical analysis

The physio chemical analysis i.e. pH, TSS and acidity of papaya and papaya-soy fruit leather were determined as per Ranganna (2012). The chemical analysis of papaya and papaya-soy fruit leather were determined as per AOAC (2005).

Yield

The yield % was determined as per Byarugaba, 2008.

$$\text{Yield} = \frac{\text{Weight of fruit leather}}{\text{Weight of pulp and soy slurry}} \times 100$$

Sensory evaluation

Sensory evaluation of papaya-soy fruit leather was carried out using 9-point hedonic rating described by Ranganna (2012). Total number of panelist were 10, who were semi-trained.

Data analysis

All experiments were carried out in triplicate and average values were reported. The data obtained in this experiment were statistically analysed by using Genstat 5 Release 12.1 software program developed by The Null Corporation (2009).

Experimental data obtained were statistically analyzed using one way Analysis of variance (no blocking) at 5% level of significance. The means were compared by using least significant method.

Results

Chemical composition of papaya pulp

The moisture content (%), TSS °Bx, pH, Acidity (% as citric acid), Vitamin C (mg/100g), Reducing sugar (%), Total ash (%), Crude fat (%), Carotene (mg/100g), Iron(mg/100g), Calcium (mg/100g) and Protein (%) are shown in table 1.

Table 1. Chemical composition of papaya fruit pulp.

Parameters	Papaya pulp*
Moisture content (%)	85.97±2.9
TSS °Bx	12.49±0.19
pH	5.92±0.02
Acidity (% as citric acid)	0.21±0.04
Vitamin C (mg/100g)	53.90±2.86
Reducing sugar (%)	5.57±0.34
Total ash (%)	0.56±0.03
Crude fat (%)	0.19±0.06
Carotene(mg/100g)	0.82±0.03
Iron(mg/100g)	0.69± 0.03
Calcium(mg/100g)	22.63±2.25
Protein (%)	0.32±0.01

*The values in the table are the means of triplicate ± standard deviation. All parameters are in dry weight basis.

Chemical composition of papaya-soy fruit leather

The chemical composition of papya-soy fruit leather is shown in table 2.

The result obtained above shows that moisture content of sample B shows no significant difference with sample A and sample C whereas there is significant difference between the rest of the samples. The moisture content between the fruit leather ranged from 11.47±0.74 in sample D (70:30) to 14.46±0.77 in sample A (control).

The mean fat content of all samples were significantly different (p>0.05). The blended product obtained from papaya pulp and soy-slurry showed increase in fat content as well as protein content and this increase is due to high fat and protein content of the soy slurry.

Table 2. Chemical composition of papaya-soy fruit leather.

Parameters	A	B	C	D
Moisture (%)	14.46 ± 0.77^{a}	$13.41\pm0.35^{a,b}$	12.89 ± 0.65^{b}	11.47 ± 0.74^{c}
Crude fat (%)	0.18 ± 0.04^{a}	0.43 ± 0.03^{b}	0.61 ± 0.04^{c}	1.02 ± 0.07^{d}
Protein (%)	1.42 ± 0.1^{a}	$1.57\pm0.09^{a,b}$	1.77 ± 0.13^{b}	2.25 ± 0.24^{c}
Total ash (%)	0.84 ± 0.09^{a}	1.42 ± 0.28^{b}	1.57 ± 0.36^{b}	2.08 ± 0.24^{c}
Calcium (mg/100g)	23.96 ± 1.72^{a}	27.81 ± 1.13^{b}	29.62 ± 1.69^{b}	32.58 ± 1.55^{c}
Iron (mg/100g)	0.73 ± 0.04^{a}	0.82 ± 0.05^{a}	1.90 ± 0.04^{b}	2.45 ± 0.18^{c}

*Means ± standard deviation bearing similar superscripts in row are not significantly different.

With the variation in the composition of fruit leathers, the ash content, calcium content and iron content showed significant difference (p>0.05) in almost all of the samples. The result shows that the control A had lowest ash content, calcium content and iron content while sample D had the comparatively highest ash content, calcium and iron content.

Physiochemical composition of papaya-soy fruit leather

The physiochemical composition of papaya-soy fruit leather at different percentage are shown in table 3.

The highest reducing sugar content of 39.46±0.77% was recorded in control (A) and lowest of 23.32±0.05% in papaya-soy leather of 70:30 ratio sample D respectively. Statistical analysis showed that beside the control (A) all of the other samples showed no significant difference to each other with the highest carotenoid content of 1.21±0.15 in control (A) and lowest of 0.87±0.07 in papaya-soy leather of 70:30 ratio sample D as for the vitamin C content the highest was of 56.01±1.15 mg/100 g in papaya-soy leather of 70:30 ratio sample D and lowest of 54.00±1.72 in control A.

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Table 3. Physiochemical composition of papaya-soy fruit leather.

Parameter	A	B	C	D
Reducing sugar (%)	39.46±0.77^{a}	30.76±1.55^{b}	27.56±1.66^{c}	23.32±1.05^{d}
pH	6±0.12^{a}	6.26±0.15^{a}	6.29±0.27^{a}	6.33±0.31^{a}
Vitamin C (mg/100 g)	54.00±1.72^{a}	55.00±1.55^{a}	55.31±1.09^{a}	56.01±1.15^{a}
Acidity (% as citric acid)	0.87±0.05^{a}	0.79±0.05^{a,b}	0.71±0.06^{b,c}	0.61±0.05^{c}
TSS (°Bx)	60.06±4.11^{a}	59.47±3.63^{a}	58.90±4.22^{a}	56.47±3.70^{a}
Carotenoid (mg/100 g)	1.21±0.15^{a}	1.01±0.03^{b}	0.91±0.06^{b}	0.87±0.07^{b}
Yield (%)	25.30±1.31^{a}	37.04±1.57^{b}	38.04±1.69^{b}	38.79±1.56^{b}

* Values are average of triplicate determinations ± standard deviation

*Values with same superscript in same row are not significantly different (p>0.05)

Acidity was found highest 0.87±0.05% in control A and lowest 0.61±0.05% in papaya-soy leather of 70:30 ratio sample D. The study showed that as the content of soy-slurry in papaya pulp increased, the titratable acidity decreased significantly due to dilution of acidic factor of the fruit with the addition of the soy-slurry. Yield % was also found to be increased in the order of sample D>C>B>A.

Sensory evaluation of papaya-soy fruit leather

The mean scores of papaya-soy leather samples on the basis of hedonic rating are shown in Figure 1.

The mean score of the papaya-soy leather in sample A (100:0), B (90:10), C (80:20) and D (70:30) was found to be 7.2±0.63, 7.5±0.85, 6.8±0.92 and 5.7±0.82 respectively. Comparing them sample B was found most preferred than other three samples. Likewise, the least score was obtained for sample D.

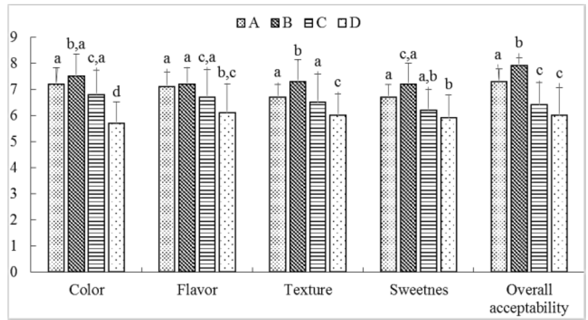

Figure 1. Mean score of sensory attributes.

In context of flavor the average score was found to be highest 7.2±0.63 in sample B (90:10) and lowest being 6.1±1.10 in sample D. The average score of sample B was found to be not significantly different to control A and sample C.

It was observed that the further increase in proportion of soy slurry in papaya pulp made it undesirable since the average score obtained in sample C (80:20) and sample D (90:10) was found to be in decreasing order.

The score for texture of the sample A, B, C and D were found to be 6.7±0.48, 7.3±0.82, 6.7±1.08 and 6.1±1.10 respectively. Evaluating them sample B was found to be preferred with highest score than other three samples. Sample B seemed to be significantly different from rest of the sample.

The sample B had the highest score in sweetness and the score seemed to be in the trend of sample B>A>C>D with D having the lowest score than others. The values obtained showed at least two samples were significantly different (p>0.05).

The highest score in the sample B might be due to the perfect blend of papaya and soy in the product. While lower score in sample C and D might be attributed to the decrease in sweetness in the product with the increase in proportion of soy slurry in the products respectively. While control A's lower score can be attributed to the excessive sweetness in the product with the sugar added.

The score for overall acceptability in sample A, B, C and D were found to be 7.3±0.48, 7.9 ±0.32, 6.4±0.84 and 6±1.05 respectively and were significantly different (p>0.05).

Discussion

The results that are included in the table shows that the TSS, pH, titratable acidity are within the range for chemical composition of ripened papaya cultivars grown in different countries (Madhava 1974; Bari *et al*. 2006). The report indicates that the properties of ripened papaya ranges: moisture content (85.9-92.6), TSS (11.42-15.6 °Bx), pH (4.03-5.96), acidity (0.05-1.15%), vitamin C (36.37-71.54) and reducing sugar (4.11-6.2). USDA (2016) showed the moisture content of ripened papaya to be 88.06%, protein 0.47%, total ash 0.64%, calcium 20 mg/100g, iron 0.25 mg/100g, vitamin C 60.9 mg/100g and crude fat 0.26%. The results obtained of the respective parameters were close to the data provided by USDA (2016). Madhava (1974) also showed the similar data for the chemical composition of ripened papaya pulp.

Increasing the amount of soy slurry in papaya pulp, the moisture content decreased due to the coarser texture of the soy slurry, moreover the increase in soy content in leather decreases the fiber content of leather and in turn the moisture retaining capacity (Endres 2001). These findings are also similar to the ones reported by Sharma (1997); Thakur (1997). Mir (1990); Sharma (1997); Anju *et al*. (2014) reported similar increasing trend in protein and fat content of their respective products when blended with soy. The ash content as well as the mineral contents are found to be higher than their fresh counterparts which may be due to reduction in moisture content as a result of processing and varietal influence as well as addition of soy blend in the product (Kumar *et al*. 2010).

Kaushal and Bhat (1999); Anju *et al*. (2014) reported decrease in sugars in fruit leathers blended with sprouted soy-slurry. The reduction in sugar % may be due to inversion of sugar to monosachharides by acid hydrolysis (Aruna *et al*. 1998). Chan and Cavaletto (1978) reported that blanching, boiling results in 89 to 95% retention in carotene. Since, same drying time temperature was used for all the samples the decreasing trend maybe contributed to the increase in soy-slurry blend. Similar findings were observed in Azeredo *et al*. (2006); Chan and Cavaletto (1978). Similar observation had been reported by Chauhan *et al*. (1993); Kaushal and Bhat (1999) and Anju *et al*. (2014). The pH was found in increasing order from control A< B< C< D. This may be due to the dilution of acidic factor of the fruit with the addition of soy-slurry. Kaushal and Bhat (1999) reported similar results in fruit leather blended with sprouted soy-slurry.

The highest score for sample B might be attributed to a better consistency of the blend. Similar results have been reported earlier by Kaushal and Bhat (1999). The reason could be assigned to the fact that leather prepared from (90:10) of papaya pulp and soy-slurry had a better consistency and flavor and due to an ideal ratio of the blend. Similar findings have been reported by Kaushal and Bhat (1999) and Anju *et al*. (2014).

Conclusion

There is an ample opportunity for utilization of soy-slurry in other fruit leather also without compromising taste. However, for papaya-soy fruit leather, the maximum percentage of fortification of soy-slurry is 10% without compromising the taste.

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