Microbial and sensory quality of value enriched smoothie

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Abstract

Value added smoothie with 1 per cent oat flour, 1 per cent whey protein concentrate, 5 per cent papaya pulp, 4 per cent sugar combination was found to be acceptable among other combinations. Storage studies evaluated by sensory score revealed that the value added stirred smoothie can be stored up to 7 days at 5ºC.

A significant increase in acidity and decrease in pH were noticed in the value added stirred smoothie during the storage period but within the permissible limits. Microbial quality of developed smoothie was good in the aspect of total count and yeast and mould count during the storage period at 5°C for 7 days.

Keywords: Smoothie, curd tension, sensory characters, value enriched dahi.

Introduction

Fermented foods are in high demand in the recent trends due to their nutritional value. The association of fruits with dairy products has endorsed health perception in consumers mind, as consumers connect both these foods with health and wellness.

Fruits are rich source of various important phytonutrients namely vitamins, minerals, antioxidants and of dietary fibers and cereals are rich in soluble fibers. Fortification of fermented milk products with fruit pulp has been shown to improve their acceptability to a considerable extent.[1] It has helped in enhancing the nutritional quality and market value of the products.

Material and Methods

Skim milk dahi: The skim milk dahi was prepared as per the procedure outlined by Aneja et al.[2]

Preparation of value added smoothie: Value added dahi (VAD) was prepared by adding oat flour and whey protein at the rate of one per cent each before pasteurization of milk. It was mixed thoroughly and it was pasteurized at 95º C for 15 minute.

Two per cent DVS culture containing *Streptococcus thermophilus* and *Lactobacillus delbrueckii* ssp. *bulgaricus* was used and inoculated at 40ºC and incubated at 42ºC /4hours until firm curd was obtained. It was used to prepare four different value added stirred smoothie by incorporating sugar at the rate of 4 per cent and papaya and fig fruit pulp at the rate of 5 per cent each.

Flow chart for value added dahi and value added stirred smoothie:

Fresh cow milk
↓
Skimming at 40^0C
↓
Addition of oat flour (1per cent), WPC (1per cent)
↓
Pasteurization (95^0C for 15 min)
↓
Cooling (40^0C)
↓
Inoculation (2 per cent culture)
↓
Incubating at 42^0C / 4hours
↓
Blending of fig, papaya fruits pulp (5 per cent)
↓
Addition of sugar (4 per cent)
↓
Packaging
↓
Storage at 5°C.

Estimation of acidity: Acidity was estimated as per the procedure described in IS: SP: 18 (part XI)-1981.

Estimation of pH: pH was estimated using an electronic pH meter.

Microbial analysis of control and value added smoothie: Total count, coliform count and yeast and mould count were estimated as per method described in IS: 1479 (Part III) - 1977.

Curd tension: Curd tension was analysed as per Chandrasekara et al.

Sensory evaluation: Random sampling was done in each batch of trial. Sensory evaluation was carried out by using nine-point Hedonic scale. All the samples were appropriately coded before subjecting for sensory evaluation.

Keeping quality of the products: The control and value added smoothie samples were evaluated for microbial and

sensory qualities on 0, 3rd and 7th day for smoothie respectively.

Statistical analysis: The values obtained were analysed statistically as per the procedure given by Snedecor and Cochran.[4]

Results and Discussion

Sensory characteristic and curd tension of control and value added smoothie: Sensory scores of skim milk dahi (SMD-control) and value added dahi (VAD) were mixed with oat flour 1 per cent, whey protein concentrate 1 per cent (Table 1). The increased score for appearance, flavor, body and texture, sourness and over all acceptability in value added dahi (VAD) may be due to the addition of whey proteins to milk. Improved body and texture in the value added dahi is due to interaction of whey protein with casein miscelles forming a rigid gell structure in smoothie.[6] Flavor score improvement may be due to volatile flavor components of oat flour.[5] Similar observation was recorded for yoghurt by Herrero and Requena[6] and in case of kefir by Sady et al.[7]

Curd tension: There was a highly significant difference (P<0.05) in curd tension value between SMD and VAD. The mean values of curd tension for SMD and VAD were 22.50 ± 0.946 and 39.17 ± 1.118 respectively. The increase in curd tension of value added smoothie was due to incorporation of whey protein concentrate and oat flour which improved the firmness. These results are closely related with the findings of Lobato- Calleros et al.[8]

Sensory characteristic of control and value added stirred smoothie: The order of preference of different levels of addition of papaya and fig fruit pulp in stirred smoothie was rated according to the overall acceptability of the sensory score. The addition of 5 per cent papaya pulp, 4 per cent sugar in VAS0 (control) was found to be highly acceptable and scored better than other combinations.

Overall acceptability score decreased in VAS2, VAS3 as to VAS0 and VAS1, it could be due to increased incorporation of fruit pulp. VAS1 scored highest sensory score for appearance, flavor, sweetness and sourness than all other combination (Table 2).

Result obtained is closely related to the findings of Rahman et al[9] and Mahmood et al. They concluded that increased level of fruit pulp than suitable limit decreased the sensory score and acceptability of the product.

pH of value added stirred Smoothie during storage at 5°C: There was no significance difference (P>0.05) for pH between VAS0 and VAS1 on 0 day but there was highly significant difference (P<0.05) on 3rd and 7th days of storage at 5°C (Table 3). As the days of storage advanced, there was a significant decrease in pH, it was in concordance with the findings of Vijayalakshmi[10] and Kamruzzaman et al.[11] The decrease in pH during storage may be correlated with the lactose consumption.

The significant change in pH especially on 3rd and 7th day of storage at 5ºC may be due to utilization of simple sugars like glucose and fructose in papaya.[13]

Titratable acidity of value added stirred Smoothie during storage at 5°C: There was no significance difference (P>0.05) for acidity between VAS0 and VAS1 on 0 day but there was highly significant difference (P<0.05) on 3rd and 7th days of storage at 5°C (Table 4). As the days of storage advanced, there was a significant increase in acidity which was in concordance with the finding of Vijayalakshmi[10] and Kamruzzaman et al[11]. The increase in acidity during storage may be correlated with the lactose consumption.[12] The significant change in acidity especially on 3rd and 7th day of storage at 5ºC may be due to utilization of simple sugars like glucose and fructose in papaya.[13]

Sensory characteristic of control and value added stirred smoothie stored at 5°C: Table 5 shows the sensory scores of control (VAD0) and VAD1 stored at 5°C. There was a significance difference (P<0.05) between control (VAD0) and VAD1 during storage at 3rd days and 7th days but no significant difference was observed on 0 day between control and VAD1. As the day advances, there was a marked reduction in score for all the sensory parameters.

Table 1
Sensory characteristic and curd tension of control and value added dahi (Mean ± SE) @

Sensory parameters	SMD	VAD	't' value
Appearance	7.53 ± 0.123	8.72 ± 0.086	8.37**
Flavor	8.08 ± 0.083	8.77 ± 0.090	7.23**
Body and texture	6.42 ± 0.101	8.86 ± 0.058	19.96**
Sourness	7.78 ± 0.113	8.75 ± 0.092	8.38**
Overall acceptability	6.86 ± 0.121	8.61 ± 0.100	13.64**
Curd tension (gm)	22.50±0.946	39.17±1.118	11.47**

@ Average of six trials; Mean value bearing different superscripts in a row differ significantly (P<0.05);
SMD-Skim Milk Dahi (control); VAD-Value Added Dahi with oat flour 1%, whey protein concentrate (WPC) 1%;
**Highly significant (p<0.01)

Table 2
Sensory characteristic of control and value added stirred smoothie (Mean±SE) @

Sensory parameters	VAS0 (control)	VAS1	VAS2	VAS3	'F' value
Appearance	$8.75^{a} \pm 0.073$	$8.81^{a} \pm 0.067$	$7.28^{b} \pm 0.194$	$7.33^{b} \pm 0.120$	46.98
Flavor	$8.89^{a} \pm 0.053$	$8.92^{a} \pm 0.047$	$7.08^{b} \pm 0.212$	$7.11^{b} \pm 0.096$	71.51
Sweetness	$8.86^{a} \pm 0.058$	$8.78^{a} \pm 0.070$	$6.72^{c} \pm 0.189$	$7.31^{b} \pm 0.131$	79.74
Sourness	$8.83^{a} \pm 0.063$	$8.92^{a} \pm 0.047$	$6.64^{c} \pm 0.155$	$7.28^{b} \pm 0.152$	96.91
Overall acceptability	$8.92^{a} \pm 0.047$	$8.89^{a} \pm 0.053$	$6.75^{c} \pm 0.175$	$7.33^{b} \pm 0.169$	75.32

@ Average of six trials; Mean value bearing different superscripts in a row differ significantly (P<0.05); VAS0 – (Value Added stirred Smoothie) with oat flour 1%, WPC1%, sugar 4%
VAS1- oat flour 1%, WPC1%, papaya pulp 5%, sugar 4%; VAS2- oat flour 1%, WPC1%, fig pulp5%, sugar 4%;
VAS3- oat flour 1%, WPC1%, papaya pulp 5%, fig pulp5%, sugar 4%

Table 3
pH of Value Added stirred Smoothie during storage at 5°C (Mean ± SE)@

Storage (Day)	VAS 0	VAS 1	't' value
0	4.56 ± 0.009	4.49 ± 0.057	1.32^{NS}
3	4.54 ± 0.012	4.46 ± 0.011	4.26**
7	4.53 ± 0.014	4.42 ± 0.006	8.66**

Table 4
Titratable acidity of Value Added stirred Smoothie during storage at 5°C (Mean±SE) @

Storage time (day)	VAS0	VAS1	't' value
0	0.76 ± 0.013	0.79 ± 0.006	1.96^{NS}
3	0.78 ± 0.011	0.88 ± 0.011	5.54**
7	0.83 ± 0.005	0.93 ± 0.015	8.44**

Table 5
Sensory characteristic of control and value added stirred smoothie stored at 5°C (Mean ± SE) @

Sensory parameters	VAS0			VAS1			'F' value
	0 day	3 day	7 day	0 day	3 day	7 day	
Appearance	$8.75^{ab} \pm 0.073^{ab}$	$8.69^{ab} \pm 0.078$	$8.61^{a} \pm 0.0782$	$8.81^{ab} \pm 0.067$	$8.78^{ab} \pm 0.070$	$8.17^{c} \pm 0.109$	9.97
Flavor	$8.89^{a} \pm 0.053^{a}$	$8.75^{ab} \pm 0.073$	$8.67^{b} \pm 0.080$	$8.92^{a} \pm 0.047$	$8.03^{c} \pm 0.028$	$7.34^{d} \pm 0.092$	85.89
Body and texture	$8.86^{a} \pm 0.058$	$8.69^{a} \pm 0.125^{a}$	$8.56^{a} \pm 0.084$	$8.78^{a} \pm 0.070$	$8.11^{b} \pm 0.131$	$7.81^{c} \pm 0.131$	17.56
Sourness	$8.83^{a} \pm 0.063$	$7.97^{b} \pm 0.109$	$7.83^{b} \pm 0.085$	$8.92^{a} \pm 0.047$	$8.03^{b} \pm 0.116$	$7.25^{c} \pm 0.108$	47.92
Overall acceptability	$8.92^{a} \pm 0.047$	$8.81^{a} \pm 0.067$	$8.14^{b} \pm 0.107$	$8.89^{a} \pm 0.053$	$8.33^{b} \pm 0.154$	$7.69^{c} \pm 0.078$	25.50

Table 6
Microbial qualitites of value added stirred smoothie during storage at 5 °C (Mean ± SE) @

Microbial qualities (log_{10} cfu/g)	VAS0 (control)			VAS1			'F' value
	0 day	3rd day	7th day	0 day	3rd day	7th day	
Total count	7.7±0.377	8.03±0.400	8.15±0.302	7.82±0.299	8.270±0.382	8.42±0.199	0.66^{NS}
Coliform count	Nil	Nil	Nil	Nil	Nil	Nil	-
Yeast and mould count	Nil	Nil	1.65±0.272	Nil	Nil	1.67±0.361	0.22^{NS}

@ Average of six trials; VAS 0 - (Value Added stirred Smoothie -control) oat flour 1%, WPC1%, sugar 4%.; VAS 1- oat flour 1%, WPC1%, papaya pulp 5%, sugar 4%.
NS: not significant (p>0.05); **Highly significant (p<0.01); *Significant (p<0.05)

This coincides with the findings of Ashaye et al,[14] Salvador and Fiszman[15] and Vijayalakshmi.[10] They reported that there was a concomitant decrease in the sensory score and general acceptability of the yoghurt during storage.

Microbial qualities of value added stirred smoothie: Table 6 shows the total counts, coliform and yeast and mould in the VAS 0 and VAS 1 stored at 5°C. The increased total count was attributed to the enhanced availability of simple sugars mainly glucose, fructose and minerals which act as a growth promoters.[13] Coliform were found to be absent in VAS0 as well as VAS1 which indicate that the product was prepared in hygienic condition and is in confirmation with the findings of Abou-Donia et al[16] and Vijayalakshmi.[10]

Conclusion

Smoothie could be enriched with 1 per cent oat flour, 1 per cent whey protein concentrate, papaya pulp 5 per cent and sugar 4 per cent. Significant increase in acidity and decrease in pH were noticed in the value added smoothie during the storage period but within the permissible level. Storage studies evaluated by sensory score revealed that the value added smoothie can be stored up to 7 days at 5 ºC.

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