

Original Research Article

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Physico-Chemical and Sensory Attributes of Developed Avocado Pulp-Carrot Juice Blended Probiotic Dahi as Effected by Different Packaging Materials

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ABSTRACT

A study was conducted for the development of value added dahi by incorporating avocado pulp and carrot juice to increase the nutritional and sensory quality. The research work was undertaken to develop the avocado pulp-carrot juice blended probiotic dahi to get functional attributes. Combination of Avocado pulp and carrot juice incorporated at the level 5.0, 10.0, 15.0 per cent, added with optimized probiotic culture (1 per cent) and combination of avocado pulp-carrot juice at 10.0 per cent was optimized for further trials. The control and developed avocado pulp-carrot juice blended probiotic dahi samples were packed in Polyethylene (C), Polystyrene (P1), Polypropylene (P2) and Polyethylene terephthalate (P3) cups. The sensory evaluation of the samples showed significant effect on sensory scores. The overall acceptability score for P3 was found to be higher 8.41 as against 8.50 for control. The control and developed avocado pulp-carrot juice blended probiotic dahi samples packed in Polyethylene (C), Polystyrene (P1), Polypropylene (P2) and Polyethylene terephthalate (P3) cups are stored at room temperature $30\pm 1^{\circ}\text{C}$. The control and developed avocado pulp-carrot juice blended probiotic dahi samples packed in Polyethylene (C), Polystyrene (P1), Polypropylene (P2) and Polyethylene terephthalate (P3) cups are stored at room temperature $30\pm 1^{\circ}\text{C}$ and analyzed for physico-chemical characteristics showed increased in acidity with decrease in pH in all the samples irrespective of the packaging material used. Moisture loss was also observed in the samples which resulted in increase of total solids and fat content to a lesser content. The packaging materials were found to have significant effect on the physico-chemical characteristics of the samples.

Keywords

Dahi, Fermented milks, Avocado pulp, Carrot Juice, value addition, Probiotics

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Introduction

Fermentation - an ideal technology to preserve milk from time immemorial. Fermentation of milk by specific micro flora accompanying a technological and using some additive induces change in taste, texture, visual appearance, colour, flavour and

nutritive properties of the milk and produces a wide variety of foods (Oberman and Libudzisz, 1998). Fermented milk products vary considerably in composition, flavour and texture according to the nature of fermenting organisms, the type of milk and the manufacturing process (Benhilda, 2007). Dahi is a well-known fermented milk product consumed by

large section of the population throughout the country, either as a part of the daily diet or as a refreshing beverage. About 8 per cent of total milk production is used for dahi making. In India, dahi is largely made at individual homes using traditional kitchen recipes, involving milk of buffaloes, cows and goats.

Generally, a mixture of cow and buffalo milk is used. Milk is boiled, cooled and inoculated with dahi starter, usually the left over from the previous day's stock and undisturbed at ambient temperature for four to six hours until it acquires a thick consistency.

Avocado is considered as nature's butter having a high proportion of fat compared to other fruits. It is a native of Tropical America It is considered as most nutritive fruit which is a rich source of vitamins, minerals, dietary fiber, proteins and fat.

The fruit is having a higher energy value of 144 kcal/100g (Prakash *et al.*, 2014). India is the largest producer of fruits and second largest producer of vegetables in the world, next only to china. Its share in the world's production is 11 per cent and 7 per cent in case of fruits and vegetables, respectively (FAO, 2006). Vegetables are indispensable for maintaining good health. For balanced diet, an adult should consume about 280 g of vegetables per day; of this about 85 g should comprise root vegetables.

The consumption of carrot and its products have increased steadily due to their recognition as an important source of natural antioxidants besides, anticancer activity of β - carotene being a precursor of vitamin A (Krishan *et al.*, 2012). Dahi is the fermented milk product with various health benefits and a vehicle to transfer nutritional values especially value addition by avocado pulp and carrot juice.

In the present work, fruit blended yogurt was developed by optimizing the different levels of avocado pulp and carrot juice, and packed in different packaging materials, The effects on the different packaging material on physico- chemical

and sensory quality of dahi of avocado pulp- carrot juice blended probiotic dahi during storage of blended probiotic dahi were done.

Materials and Methods

Pasteurized and homogenized toned milk obtained from Nandini milk parlour Ganganagar, Bengaluru, was used for the preparation of avocado pulp-carrot juice blended probiotic dahi. Dahi cultures such as *Lactococcus lactis ssp lactis*, *Lactococcus lactis* bv. *diacetylactis*, *L. plantarum* and lactose fermenting yeasts in the form of freeze-dried direct Vat set (FD-DVS), Probiotic cultures such as *Bifidobacterium bifidum* in the form of freeze-dried direct Vat set (FD-DVS) was obtained from Chr. Hansen Laboratories, Copenhagen, Denmark. Processed Avocado pulp was procured from "Saldanha's fresh avocado"- Mumbai. Fresh carrot was procured from the local market and juice extracted is used in the preparation of avocado pulp-carrot juice blended probiotic dahi. Stainless steel vessels of varying capacities and Stainless-steel stirrers were used at various stages of the investigation.

Glassware's such as, conical flasks, beakers, volumetric flasks and measuring jars of Borosil were used for preparation of avocado pulp-carrot juice blended probiotic dahi.

The chemicals and reagents used were mainly of highest purity, commercially available analytical grades. All the aqueous reagents used were freshly prepared. The chemicals and reagents used were mainly of highest purity, commercially available analytical and HPLC grades. All the aqueous reagents used were freshly prepared. The following chemicals were employed in the experimental work, Gerber 's sulphuric acid – 95 per cent, Amyl alcohol – 70 per cent, Ethyl Alcohol, (95 per cent v/v), Sodium hydroxide - 0.1N, Phenolphthalein indicator and StrontiumHydroxide- 0.1N.

The procedure followed by Lee and Lucey (2010) (Figure 1) for preparation of control dahi was adopted with suitable modifications (Figure 2).

Packaging materials such as polyethylene (PE), polystyrene (PS), polypropylene (PP), and polyethylene terephthalate (PET) jars of standard size 200 ml were used for packaging of avocado pulp-carrot juice blended probiotic dahi which was procured from Grace International, Valiv Vasai, Thane. Chemical analysis of avocado pulp-carrot juice blended probiotic dahi for fat, Total solids, titratable acidity and pH was done as per the procedure stated in IS: SP 18 (Part XI) 1981.

Avocado pulp-carrot juice blended dahi samples were given to a panel of five judges for sensory evaluation. Each judge was supplied with standard score card of a total of 9 Point Hedonic Scale (Annexure-1) for colour and appearance, body and texture, flavor and overall acceptability.

The keeping quality of developed avocado pulp-carrot juice blended probiotic dahi and control samples were tested for 3 days at room temperature of $30\pm 1^{\circ}\text{C}$ the stored samples were drawn and analyzed for physico-chemical and sensory parameters at 1-day interval. Also, the samples were stored at refrigeration condition ($5\pm 1^{\circ}\text{C}$) for 9 days and were examined for physico-chemical and sensory parameters during storage at 3 days interval. The scores given by panel of judges were then statistically analyzed. The samples were code numbered to avoid identification and bias.

The data was analyzed using R software {R Programme, R-Version 3.1.3(2015- 3-09), Copyright © 2015} both one way and two way Completely Randomized Design (CRD) which is the most appropriate for the study. Data on the response variables were collected for three replications for each of these treatments.

Results and Discussion

The control and developed dahi samples (on fresh day) packed in polyethylene (C), polystyrene (P1), polypropylene (P2) and polyethylene terephthalate (P3) cups, were subjected to sensory evaluation, the results pertaining to the effect of different packaging

materials on the sensory attributes are tabulated in Table 1 and Figure 1. The sensory scores awarded for Control, P1, P2 and P3 with respect to colour and appearance were 8.42, 8.38, 8.40 and 8.48, respectively. Similarly, the sensory scores for body and texture were 8.40, 8.28, 8.28 and 8.33, respectively. The sensory scores awarded for flavour attribute were 8.50, 8.26, 8.38 and 8.38, respectively.

The overall acceptability scores were found to be 8.46, 8.28, 8.20 and 8.33 respectively. P3 has highest sensory score with respect to Control, when compare to P1 and P2. Statistical analysis revealed that packaging materials had non-significant effect on sensory quality of control and developed avocado pulp-carrot juice blended probiotic dahi.

The fresh samples of control and developed avocado pulp and carrot juice blended dahi was packed in Polyethylene (C), Polystyrene (P1), Polypropylene (P2) and Polyethylene terephthalate (P3) cups, were subjected to sensory evaluation (presented in Table 1). The physical appearance of dahi plays an important role in consumer acceptability. Influence of different packaging materials on the developed avocado pulp and carrot juice blended dahi was observed in Table 1. The statistical analysis for data obtained for sensory evaluation indicates a significant effect of packaging material on sensory characteristic of the samples for all sensory attributes.

The samples stored in PET cups were awarded highest appearance score of 8.48 with respect to control 8.42. Similarly, for body and texture attribute, the control and the product packaged in PET cups were awarded highest average score of 8.40 and 8.33 out of 9 respectively.

Similarly, for flavour attribute, the control and the product packaged in PET cups were awarded highest average score of 8.50 and 8.38 out of 9 respectively when compared to P1 and P2. The developed products packed in PET cups were awarded the highest scores for overall acceptability of 8.33

against control (8.46) respectively. The observations are conformity of the findings Sarker *et al.*, (2018) for carrot juice added dahi. Similar observations (PET 8.65) were also recorded during sensory analysis of enriched misti dahi incorporated with WPC and fruit juices (Patricia, *et al.*, 2016). Further, these packaging materials were observed for shelf life of the developed avocado pulp and carrot juice blended dahi

The results pertaining to the effect of different packaging materials on the physico-chemical quality of fresh quality of developed avocado pulp-carrot juice blended probiotic dahi is tabulated in Table 2. The data revealed total solids on fresh day were recorded for control (13.0) and the scores of P1, P2 and P3 were 17.10, 17.11 and 17.10 respectively.

The fat percent was recorded for Control, P1, P2 and P3 was 3.00, 3.52, 3.52 and 3.53 respectively. Statistical analysis revealed that there was no significant difference with respect to total solids and fat among all the experimental samples for fresh day.

The maximum acidity value for P2 and P3 was found to be 0.71 per cent Lactic acid with corresponding pH of 4.57. Lowest acidity value for Control, P2 and P3 were found to be 0.69, 0.71 and 0.71 respectively and corresponding pH content for sample recorded for Control (4.60) while for P2 and P3 were 4.57 and 4.57 respectively. The data revealed that there was significant difference between control and samples for fresh samples

On first day of storage ($30\pm 1^{\circ}\text{C}$) the control sample recorded total solids, fat, acidity (per cent lactic acid) and pH were, 13.01, 3.01, 0.75 and 4.52 per cent respectively, whereas total solids and fat content for P2 and P3 were 17.11, 3.52 and 17.12, 3.53 respectively.

The acidity and corresponding pH value for P2 and P3 was found to be 0.73 per cent lactic acid with 4.43 pH. P1 sample recorded total solids, fat, acidity and pH were, 17.12, 3.52, 0.74 and 4.51 per cent

respectively. The control and P3 samples stored at $30\pm 1^{\circ}\text{C}$ recorded for total solids, fat, acidity in per cent lactic acid with corresponding pH were 13.02, 3.02, 0.81 and 4.31 and 17.11, 3.54, 0.82 and 4.32 respectively, whereas respective values for P1 and P2 were 17.11, 3.53, 0.84 and 4.31 per cent and 17.10, 3.55, 0.83 and 4.31 per cent, where acidity slightly increased with corresponding reduced pH values. Similar trend was observed on third day of storage at $30\pm 1^{\circ}\text{C}$.

The control, P2 and P3 samples recorded total solids, fat, acidity in per cent lactic acid with corresponding pH were 13.02, 3.12, 1.01 and 4.23 per cent, 17.11, 3.56, 1.05 and 4.20 and 17.12, 3.55, 1.03 and 4.22 per cent respectively. Out of others P1 was unacceptable on 3rd day whereas P2 and P3 was unacceptable on 4th day.

It was observed that there was visible mold growth in these samples; hence they are considered as spoiled. There was non-significant difference among all the samples for total solids and fat and significant difference for acidity and pH.

The control and samples of developed avocado pulp-carrot juice blended probiotic dahi packed in different packaging materials at room temperature were analyzed for their chemical quality at 1-day interval. The effect of different packaging materials on the chemical quality of control and avocado pulp-carrot juice blended probiotic dahi stored in ambient room temperature are tabulated in Table 2.

On fresh day, there was a significant increase in the per cent of total solids content of all samples was observed (Table 2). The higher levels of total solids content in the developed avocado pulp-carrot juice blended probiotic dahi sample could be due to exopolysaccharide production with complex viscosity during storage. The results are in agreement with Gunawardhana and Dilrukshi (2016). On day 1, there was slight increase in acidity (0.08 % LA) with reduced pH (0.1) values were noticed this may be due to microbial activity. On day 2, there was significantly higher acidity

levels was recorded for P1 and P2 (0.84 and 0.83 per cent lactic acid) with corresponding pH of 4.30 and 4.31, compared to control and P3 samples (0.81 and 0.82 per cent lactic acid) with corresponding pH values of 4.31 and 4.32. The control recorded lower levels of acidity with corresponding pH compared to P1 and P2 samples. The moisture and acidity content of coconut milk and kiwi fruit pulp enriched dahi were increased than control (due to high content of these in fruit) similar observation was recorded by Kabir *et al.*, (2014), conducted the research to prepare fruit dahi with different level of fruit juice of different fruits and found that moisture and acidity contents of fruit dahi were increased than plain dahi.

Similarly, on 3rd day sample P2 was unacceptable. Sample P3 had acidity of 1.02 per cent lactic acid and control of 1.01 per cent lactic acid mainly due to higher activity of lactic acid bacteria at room temperature. Total solids and fat content were increased irrespective of the packaging material used. On 4th day of storage control P1, P2 and P3 were unacceptable, since it was observed that there was visible mold growth in these samples with off-flavour development, hence they are considered as spoiled.

According to Sarker *et al.*, (2018), curd was prepared using carrot juice, by fermentation using starter cultures. The results obtained show that the acidity of the various products ranged from 0.70-0.93. El Zubeir *et al.*, (2007), reported that when acid production increased the quality of dairy products is affected based on sensorial characteristics due to sour taste and gas formations. Johanson and Alford (1987) indicated that standard curd should have acidity values in the range of 0.70 per cent to 0.90 per cent.

Results in table number 3 shows the effect of different packaging material on all sensory attributes. The control and developed dahi samples packed in Polyethylene (C), Polystyrene (P1), Polypropylene (P2) and Polyethylene terephthalate (P3) cups, were subjected to sensory evaluation, the results obtained for all sensory attributes is tabulated in Table 3. The

sensory scores obtained on day 1 with respect to colour and appearance for Control, P1, P2 and P3 were 8.40, 8.33, 8.34 and 8.40 respectively. Similarly, the sensory scores obtained on day 2 with respect colour and appearance for Control, P1, P2 and P3 were 8.25, 7.50, 7.50 and 8.16 respectively.

The sensory scores obtained on day 3 with respect to colour and appearance for Control, P2 and P3 were 7.59, 7.10 and 7.60, whereas P1 was unacceptable. On day 4, Control, P2 and P3 were unacceptable.

The sensory scores obtained on day 1 with respect to body and texture for Control, P1, P2 and P3 were 8.34, 8.20, 8.21 and 8.32 respectively. Similarly, the sensory scores obtained on day 2 with respect body and texture for Control, P1, P2 and P3 were 8.16, 7.90, 7.25 and 7.60 respectively. The sensory scores obtained on day 3 with respect body and texture for Control, P2 and P3 were 7.50, 7.25 and 7.60 whereas P1 was unacceptable. On day 4, Control, P2 and P3 was unacceptable.

The sensory scores obtained on day 1 with respect to flavour for Control, P1, P2 and P3 were 8.45, 8.24, 8.33 and 8.40 respectively. Similarly, the sensory scores obtained on day 2 with respect flavour for Control, P1, P2 and P3 were 8.25, 7.50, 7.60 and 8.00 respectively.

Out of different packaging material P1 and P2 significantly secured lower scores compared to Control and P1 with respect to all sensory attributes. On day 1, all the samples secured good sensory attribute scores.

On day 2, dry surface was observed in P1 and P2 product and due to this, sensory score was reduced. This might be due to increased total solids content in the product during storage with complex viscosity and thickness perception increased due to exopolysaccharide production. The results are in agreement with Tarakci, Z. and Kucukoner (2003) with respect to sensory attributes.

Table.1 The effect of different packaging materials on sensory quality of avocado Pulp-carrot juice blended probiotic dahi (Fresh day)

Packaging Material	Color and appearance	Body and Texture	Flavour	Overall acceptability
Control	8.42 ^a	8.40 ^a	8.50 ^a	8.46 ^a
P1	8.38 ^a	8.28 ^b	8.26 ^a	8.28 ^a
P2	8.40 ^a	8.28 ^b	8.38 ^a	8.20 ^a
P3	8.48 ^a	8.33 ^a	8.38 ^a	8.33 ^a
CD(P≤0.05)	NS	NS	NS	NS

Note

All values are average of three trials

Similar superscripts indicate non – significance at the corresponding critical difference treated samples contain dahi with combination of avocado pulp and carrot juice (10%)

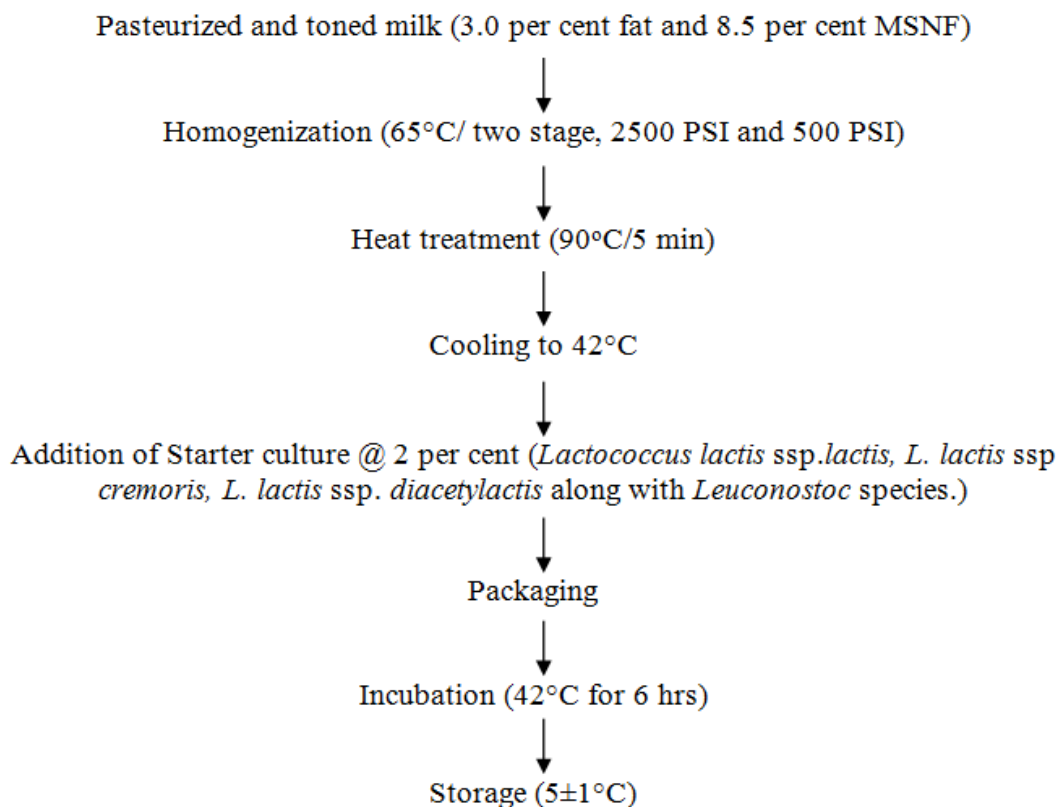
C – Control of dahi packed in Polyethylene cups

P1 – Developed dahi packed in Polystyrene cups

P2 - Developed dahi packed in Polypropylene cups

P3- Developed dahi packed in Polyethylene terephthalate cups

Flowchart.1 The flow diagram for the preparation of control dahi



Flowchart.2 The flow diagram for the preparation of avocado pulp-carrot juice blended probiotic dahi

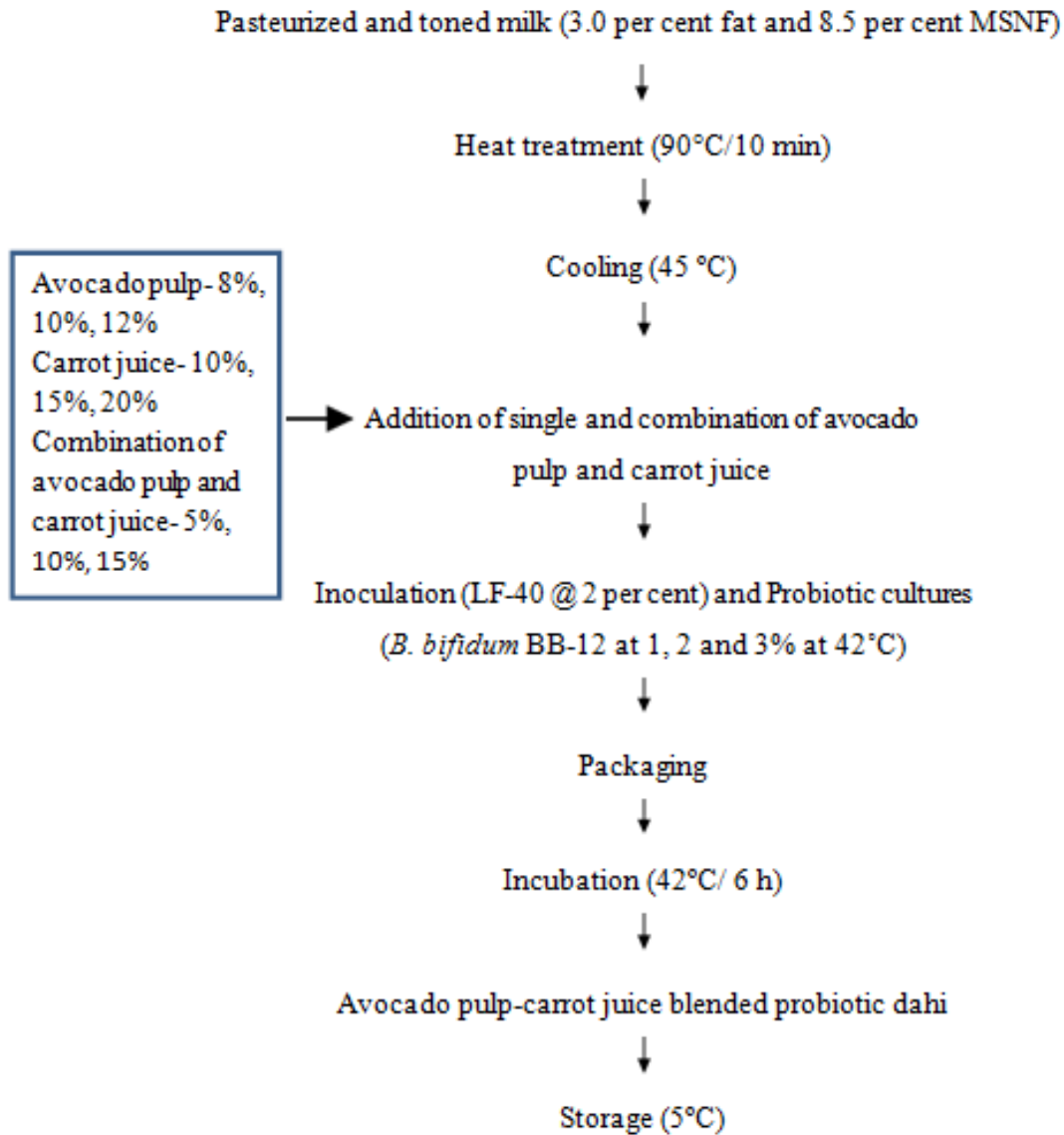
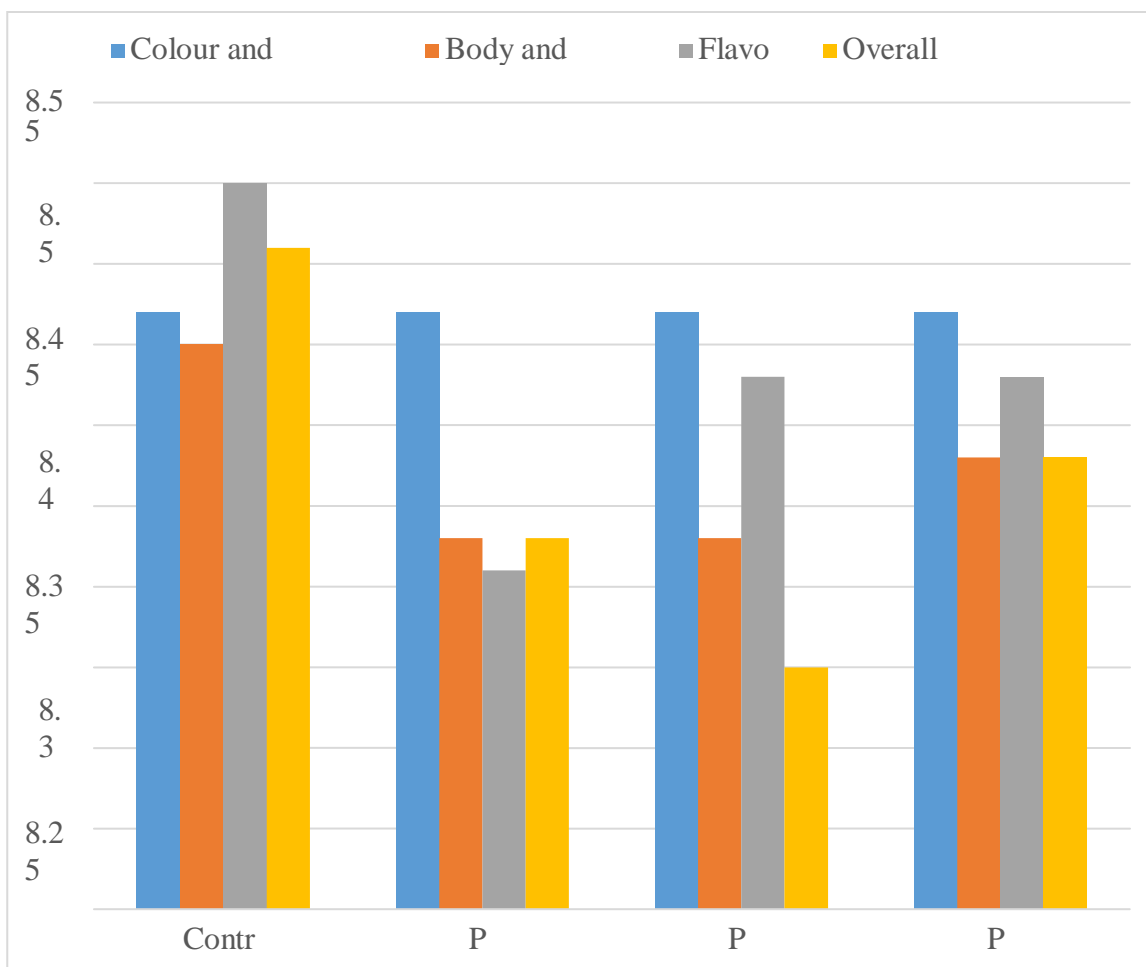


Fig.1 The effect of different packaging materials on the sensory quality of avocado pulp-carrot juice blended probiotic dahi (Fresh day)



On day 3, among different packaging material sample P1 was not acceptable which is mainly due formation of slimy layer on the surface of product with syneresis and strong acidic flavour observed. On day 4, of storage all sample were unacceptable due to dry body, coarse texture and off-flavour.

On 4th day of storage control was unacceptable. It was observed that there was visible mold growth in these samples with off-flavour development, hence they are considered as spoiled. The sensory scores were significantly different ($P < 0.05$) at the beginning and at the end of the 3 days.

Effect of different materials on the physico-chemical characteristics of developed avocado pulp-

carrot juice blended probiotic dahi stored at refrigeration temperature $5 \pm 1^\circ\text{C}$ is presented in Table 4. As could be seen from the Table 4, on 0th day i.e fresh, the total solids and fat per cent recorded for Control, P1, P2 and P3 were 13.0, 17.10, 17.11, 17.10 and 3.00, 3.52, 3.52, 3.53 respectively.

The acidity and corresponding pH value for Control, P1, P2 and P3 were 0.69, 0.71, 0.72, 0.72 per cent lactic acid and 4.6, 4.56, 4.49, and 4.53 respectively. The data revealed that there was significant difference between control and samples. On 3rd day of storage, the total solids and fat per cent recorded for Control, P1, P2 and P3 were 13.10, 17.11, 17.13, 17.12 and 3.10, 3.54, 3.53, 3.54

respectively. The acidity (per cent lactic acid) and corresponding pH content for Control, P1, P2 and P3 were 0.71, 0.75, 0.76, 0.75 and 4.60, 4.57, 4.58, 4.57 respectively. On 6th day of storage, the total solids and fat per cent recorded for Control, P1, P2 and P3 were 13.10, 17.11, 17.13, 17.12 and 3.11, 3.54, 3.53, 3.55 respectively. The acidity (per cent lactic acid) and corresponding pH content for Control, P1, P2 and P3 were 0.82, 1.10, 1.10, 1.01 and 4.22, 4.15, 4.12, 4.28 respectively. On 9th day of storage, the total solids and fat per cent recorded for Control, P1, P2 and P3 were 13.1, 17.13, 17.14, 17.13 and 3.02, 3.54, 3.55, 3.57 respectively. The acidity (per cent lactic acid) and corresponding pH content for Control, P1, P2 and P3 were 0.89, 1.12, 1.11, 1.03 and 4.20, 4.12, 4.11, 4.22 respectively. The data revealed that there was significant difference between control and samples.

On 10th day of storage all samples were unacceptable, due to increased acidity values with reduced pH. The data revealed that there was significant difference between control and samples.

The control packed in Polyethylene (C) and developed avocado pulp-carrot juice blended probiotic dahi was packed in Polystyrene (P1), Polypropylene (P2) and Polyethylene terephthalate (P3) cups, were stored at refrigeration temperature. The effect of different packaging materials on the chemical characteristics of the samples is tabulated in Table 4.

Upon storage there was loss of moisture in all the samples with subsequent increase in total solids and fat content. The findings are in accordance with Sonawane *et al.*, (2007) observed significant moisture loss in shrikhand samples during storage at refrigeration temperature irrespective of packaging materials. Similar studies regarding effect of packaging materials on the acidity and pH of dahi by Usha *et al.*, (2012) revealed that on prolonged storage acidity increased irrespective of the packaging material used, thus making it unpalatable for human consumption. Therefore, different methods are applied to restrict the growth of spoilage undesirable microorganisms.

Research work at NDRI, Bengaluru has shown that bottled curd of long keeping quality can be prepared by using selective strains of LAB (Salwa, Aly, *et al.*, 2004). The extent of increase in acidity and decrease in pH was comparatively slow in refrigeration condition compared to product stored in room temperature. This may be due to their higher Oxygen Transmission Rate (OTR) and Water Vapour Transmission rate (WVTR). Thus rate of increase in acidity and rancidity may be attributed due to increase in the microbial count that in turn leads to high metabolic activity by microorganism as constituents of dahi enriched with avocado pulp and carrot juice.

The effect of different packaging materials on the sensory quality of developed avocado pulp-carrot juice blended probiotic dahi stored at refrigeration temperature ($5\pm 1^{\circ}\text{C}$) was studied and the results are presented in table 5. The result of sensory evaluation reflects that at 3rd day of storage the sensory scores with respect colour and appearance for Control, P1, P2 and P3 were 8.40, 8.33, 8.33 and 8.66 respectively. The body and texture scores were 8.34, 8.29, 8.35 and 8.62 respectively.

The sensory scores awarded for flavour attribute were 8.45, 8.25, 8.25 and 8.60 respectively and overall acceptability scores were found to be 8.42, 8.30, 8.45 and 8.55. Statistical analysis revealed that packaging materials had significant effect on sensory quality of control and developed avocado pulp-carrot juice blended probiotic dahi.

The sensory scores on 6th day with respect to colour and appearance for Control, P1, P2 and P3 were found to be 8.36, 8.22, 8.20 and 8.44 respectively. The body and texture scores were 8.29, 8.28, 8.20 and 8.46 respectively. The sensory scores awarded for flavour attribute were 8.25, 8.10, 8.09 and 8.40 respectively and overall acceptability scores were found to be 8.42, 8.18, 8.16 and 8.51 respectively for Control, P1, P2 and P3. There was significant difference between all the samples. The sensory scores on 9th day with respect to colour and appearance for Control, P1, P2 and P3 were found

to be 8.22, 7.86, 7.82 and 8.28 respectively. The body and texture scores were 8.24, 7.81, 7.84 and 8.30 respectively. The sensory scores awarded for flavour attribute were 8.24, 7.85, 7.80 and 8.24 respectively and overall acceptability scores were found to be 8.24, 7.90, 7.99 and 8.33 respectively for Control, P1, P2 and P3. There was significant difference between all the samples. Finally, 10th day all developed samples were not acceptable.

The samples were subjected to sensory evaluation at 3-day interval (presented in Table 5). The sensory score for all the samples decreased during storage period. There was significant effect on all sensory attributes of all the samples with respect to control. P3 secured significantly higher scores than P1 and P2 this is mainly because it retained the freshness of product. All samples were unacceptable at 10th day due to surface discoloration, higher levels of syneresis and off odor. Also, it was observed that there was visible mold growth in these samples with off-flavour development, hence they are considered as spoiled.

The shelf life of avocado pulp-carrot juice blended probiotic dahi may be attributed due to increase in the microbial count and lactase enzyme. Dagher and Ali (1985) reported that destruction of yoghurt bacteria increased progressively with increase in heat treatment (ruptures cell wall), because of slower production of acid during storage take place in all the packaging materials. It can be concluded that developed product packed in PET had secured highest sensory scores and had shelf life of three days at room temperature ($30\pm 1^{\circ}\text{C}$) and 9 days at refrigeration temperature ($5\pm 1^{\circ}\text{C}$) without affecting sensory attributes significantly.

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