Development of Avocado (*Persea americana*) Incorporated Set Yoghurt

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Introduction

Yoghurt is one of the best known of all cultured-milk products in the world. According to SLS standards (1989) *Streptococcus thermophillus* and *Lactobacillus bulgaricus* are used to convert lactose in milk in to lactic acid during yoghurt production. Fruit yoghurt is produce by adding fruits and their nectars, jams, marmalade, fruit jellies, fruit drinks, fruit syrups and concentrated fruit drinks to yoghurt or cultured pasteurized milk and fruit yoghurts enhances versatility of taste, color and texture for the consumer (Chandan and Shahani, 1993).

Avocado (*Persea americana*) is a fruit which is having a very good nutrient profile and thus incorporation endorses the healthy image of yoghurts. However, incorporation of avocado in to set yoghurt is limited by enzymatic browning or formation of brown color melaniodins from polyphenol oxidase enzyme in avocado (Bindesh, 2010). Pauker *et al.* (1992) have found incorporation of avocado in to yogurt in the form of fresh avocado pulp is impossible due to enzymatic browning. Therefore, control of enzymatic browning is essential in producing avocado incorporated set yoghurt. Current study was carried out to develop avocado incorporated set yoghurt that is having an adjusted solid content based on sensory properties and controlling enzymatic browning of avocado pulp.

Methodology

Market available fresh ripened avocados (Fuerte variety) were manually peeled and crushed in to a smooth pulp. It was divided in to seven samples with same weight and preserved using several preserving and enzymatic browning control methods such as 1% citric acid, 1% (w/w) ascorbic acid (Patricia *et al*., 1993), 1% (w/w) citric acid and 1% (w/w) ascorbic acid together (Lopez, 2001), 0.1% (w/w) sodium benzoate (Patricia *et al*., 1993), 0.1% (w/w) potassium sorbate (Singha, 2011), heat treatment at 40 ºC temperature for 30 minutes (Cantwell, 1992) and preparation of avocado pulp as a jam (Connelly, 2013). The best avocado pulp preserving method (least color changing treatment) was selected by conducting a sensory evaluation using 30 untrained panelists.

The selected method of preserving avocado pulp (avocado jam) was used in preparation of avocado incorporated set yoghurt. Yoghurt mix preparation was done according to Pande (2010). Preliminary trials were used to select the appropriate level of ingredients (avocado

jam, sugar and gelatin). Sugar and gelatin levels were finalized after having several sensory trials using 30 untrained panelists. Potassium sorbate 0.03% (w/w) was added to the final mixture as preservative (SLS Standards, 1989) and homogenized using a beater (National™, MK-H100N). Inoculation of lactic acid bacteria culture of YC 350 freeze dried (DVS) was done at 45 °C temperature. Then mixture was poured in to 80 mL plastic yoghurt cups and incubated at 42 ±2 ˚C for 4 hours. Each treatment consisted with three replicates.

Total plate count, coliform bacteria count, yeast and mold count, pH, titratable acidity and peroxide value of selected avocado incorporated set yoghurt and avocado jam was tested at 1st, 3 rd, 5th, 7 th, 9th and 11 th day under refrigerated storage. A proximate analysis was done to determine the composition of the avocado incorporated set yoghurt.

Results and Discussion

Addition of 50% (w/w) sugar in to avocado pulp showed lowest brown color development ($P<0.05$). Added sugar may have reduced the water activity of the avocado pulp. Enzymes require certain level of water in their structures to maintain their natural conformation, allowing them to deliver their full functionality. Therefore, presence of 50% sugar inhibits the activity of polyphenol oxidase enzyme. Adding more than 50% of sugar, crystalize sugar in the avocado pulp which gives undesirable consistency. Twenty percent of avocado jam incorporation level shows the best results according to the sensory evaluation ($P<0.05$).

Total plate count, yeast and mold and coliform counts of the avocado incorporated set yoghurt were not exceeding SLS standards for set yoghurt during 11 days of refrigerated storage. Titratable acid percentage of avocado jam has increased from 1.22±0.07 to 1.4±0.07 during day 1 to day 11 ($P<0.05$). It may be due to conversion of fermentable sugars in to acids by microorganisms available in avocado jam. Further, titratable acid percentage of avocado incorporated set yoghurt increased from 0.86±0.03 to 0.94±0.03 during 11 days storage period ($P<0.05$). This is due to the presence of live lactic acid bacteria in culture which ferment lactose in milk to lactic acid with the time (Chandan and Kilara, 2013). pH of avocado jam and pH of avocado incorporated set yoghurt was reduced from 3.52±0.06 to 3.35±0.06 and from 4±0.03 to 3.91±0.03, respectively during day 1 to day11. Increasing acidity results in decreasing pH level in the product.

No fatty acid oxidation was detected in the avocado jam during storage period of 11 days. Avocado incorporated set yoghurt started free radicle formation and rancidity development 7th day of storage onwards. Moreover, it shows increasing browning effect. Since, avocado is a fruit with high fat and it contains considerable level of fatty acids, there is a potential to observe oxidation in this product. Statistical analysis showed that enzymatic browning has an influence on the increment of changing rapidity of titratable acidity, pH and peroxide value. Further, it showed fatty acid oxidation and pH are not related. In the view of avocado incorporated set yoghurt and avocado jam, avocado jam is having very low water activity due to saturated sugar solution. Avocado incorporated set yoghurt is having an environment with increasing acidity and decreasing pH with lactic acid fermentation. Water activity of avocado incorporated set yoghurt also very high compared to avocado jam. These factors may have influenced on the observed color change in avocado incorporated set yoghurt.

Proximate analysis of avocado incorporated set yoghurt showed that there is a significant difference with plain yoghurt ($P<0.05$). Fat (3.6±0.42%), fiber (0.3±0.21%), ash (0.9±0.14%), protein (3.5±0.07%) and total solids (16.10±1.31%) in avocado incorporated set yoghurt is comparatively higher than available fat (3.0±0.42%), fiber (00±0.21%), ash (0.7±0.14%), protein (3.4±0.07%) and solids (14.24±1.31%) in plain yoghurt.

Conclusion

Avocado incorporated set yoghurt is more nutritious compared to set yoghurt as it has included with more protein, minerals and fiber. There is a relationship between enzymatic browning and fatty acid oxidation. Further studies are required to identify how enzymatic browning and fatty acid oxidation relates with each other and to extend the shelf life of avocado incorporated set yoghurt.

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