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Sensory and microbiological evaluation of dahi added with strawberry polyphenols extract and *Lactobacillus rhamnosus* GG

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Abstract
In the present investigation strawberry polphenols fortified dahi was prepared with the addition of strawberry polyphenols extract @ 500 ppm. Milk was fermented with the probiotic culture *Lactobacillus rhamnosus* GG and mesophillic mixed dahi culture in 1:1. The prepared dahi was compared for sensory and microbiological parameters to control dahi during storage period of 3 weeks at refrigeration temperature 4 ºC. Sensory scores of control and polyohenols fortified dahi were observed to be significantly (p<0.05) different except scores of consistency and product quality. Counts of *Lactobacillus rhamnosus* GG were also present at an acceptable level (>10^7). *Lactococci* counts in both control and polyphenol fortified dahi were stable upto 7 days and thereafter one log reduction in counts was observed.

Keywords: Sensory, microbiological, dahi, strawberry polyphenols, *Lactobacillus rhamnosus* GG

Introduction
Phenolic compounds in fruits and vegetables have various bioactive components that possessed the bioactive properties like antioxidant, ACE inhibitory, antidiabetic etc. (Lin *et al.*, 2016) [17]. Incorporation of these bioactive components in milk and milk products can be considered as a better pool of biofunctional properties. Certain side effects of synthetic drugs used to cure abnormalities in the body has led the development of functional foods. Health conscious people are more attractive toward to the natural remedies to prevent diseases or abnormalities. So keeping in view of market demand and ill effects of synthetic drugs, inclusion of bioactive components in the diet is of major concern. Among fruits, strawberry cultivar is rich source of phenolic phytochemicals.
Fermented dairy products like dahi or yoghurt also have health proven proven properties. It is also widely consumed at every household in India. Therefore, fortification of strawberry polyphenols in dahi can be a healthier approach to deliver these bioactive components. Further addition of probiotic culture to polyphenols fortified dahi can further enhance its functionality. Hence objective of current study was to fortify dahi with the strawberry polyphenols with the inclusion of probiotic culture i.e. *Lactobacillus rhamnosus* GG.

Material and methods
Cow milk was collected from cattle yard, National dairy research Institute, Karnal, Haryana. Strawberry fruit pulp was obtained from M/S delta Nutritive Pvt. Ltd., Mumbai. Dahi culture (NCDC 167) and probiotic culture (Lactobacillus rhamnosus GG) was obtained from National Collection of Dairy Cultures, National dairy research institute, Karnal, Haryana.

Cultures procurement
Mesophilic mixed dahi culture NCDC 167(*Lactococcus lactis* ssp. *lactis, Lactococcus lactis* ssp. *diacetylactis, Lactococcus lactis* ssp. *cremoris* along with *Leuconostoc* spp.) and *Lactobacillus rhamnosus GG* (probiotic culture) were propagated at 30 ºC for 24 hr. and 37 °C for 24 hr. in M-17 and MRS broth.

Preparation of strawberry polyphenols fortified dahi
Strawberry polyphenols extract fortified dahi was prepared using the method developed by Singh *et al.*, 2012 with modifications. Mesophillic mixed dahi culture and *Lactobacillus*

rhamnosus GG were added @ 1% to ferment milk. Strawberry polyphenols extract was added @ 500ppm after fermentation.

Sensory evaluation of strawberry polyphenols fortified dahi
Sensory evaluation of polyphenols fortified dahi was performed using 9 point hedonic scale with a panel of 5 judges.

Microbiological analysis of strawberry polyphenols extract fortified dahi
Prepared control and polphenol extract fortified dahi was assessed for *Lactococci*, *Lactobacilli*, coliform counts, yeast and mold during storage period of 3 weeks at refrigeration temperature 4ºC.

***Lactococci* and Lactobacilli counts determination**
Lactococci and lactobacilli counts of control and polyphenols fortified dahi were estimated according to procedure described in Laboratory manual –Method of analysis of milk and milk products (MIF, 1959).

Coliform count estimation
Coliform counts in control and strawberry polyphenols extract fortified dahi were estimated using pour plate method described by Hought by *et al* (1992) Colonies with dark red coloration were counted and expressed as log cfu per gm of sample.

Statistical Analysis
Data was analyzed statistically in MS Excel software at 5% level of significance. Data are expressed as mean ± standard deviation. Analysis during storage was performed by two way ANOVA.

Results and Discussion
Preparation of strawberry polyphenols dahi
Strawberry polyphenols fortified dahi was fermented with probiotic culture and mesophillic mixed dahi culture in 1:1. Set dahi with acidity (0.81% lactic acid and pH 4.8) was stirred and added polyphenols extract @ 500 ppm. aspartame as low calorie sweetener was also added @ 65 ppm.

Sensory evaluation of strawberry polyhenols fortified dahi
Sensorial assessment of strawberry polyphenols extract fortified dahi was performed on 1st day of manufacture. Scores obtained after sensory evaluation showed that, the flavor and appearance of control and strawberry polyphenols fortified dahi differ significantly (p<0.05) but there was no significant (p<0.05) difference observed for product consistency (Table 1). Overall acceptability of polyphenol fortified dahi was better than the control dahi.

Table 1: Sensory attributes of control and polyhenol fortified dahi

Attributes	Control Stirred Dahi	Polyphenol fortified dahi
Flavour	7.4 ± 0.06^{A}	8.9 ± 0.1^{B}
Consistency	7.36 ± 0.08^{A}	7.42 ± 0.07^{A}
Appearance	7.3 ± 0.16^{A}	8.9 ± 0.1^{B}
Product acidity	7.8 ± 0.08^{A}	7.9 ± 0.05^{A}
Overall acceptability	7.8 ± 0.25^{A}	8.6 ± 0.18^{B}

Mean ± S.E, n=5, Means with different superscript (A, B) in each column and row (a, b) differ significantly (p<0.05) significantly from each other.

Microbiological changes during storage period
Yeast and mold counts and coliform counts were observed to be nil in both control and polyphenol fortified dahi during storage period of 3 weeks at refrigeration temperature 4 ºC.

***Lactobacillus rhamnosus GG* counts determination**
Counts of Lactobacillus rhamnosus GG were evaluated for 3 weeks at refrigeration temperature 4ºC. As displayed in Fig 1, counts were observed to be at an acceptable level (> 10^7) in both control and polyphenol fortified dahi.

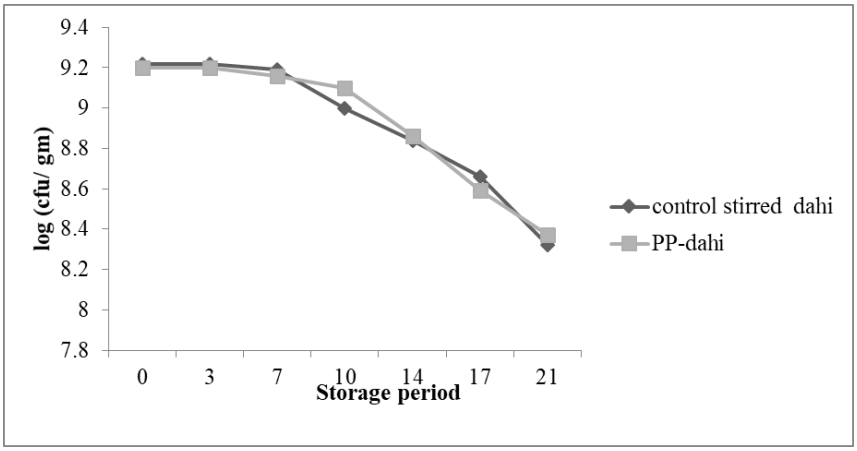

Fig 1: *Lactobacilli* counts of control and polyphenol fortified dahi during storage

Probiotic organism should be used as probiotic adjunct to remain viable and remain active as dietary adjunct during storage until consumption (Hull *et al.*, 1992). To exhibits the probiotic effects viable counts of 10^7 cfu/ml is essentiality. Similarly Con *et al.*, 1996 also observed that addition of fruit flavours like oranges, cherries and strawberries into yoghurt

causes a non significant (p>0.05) effect on the growth of bacteria. Bakirci and Kavaz (2008) observed that incorporation of banana purees and sugar to yogurt resulted in an improvement of viable counts of *L acidophilus* and *Bifidobacterium spp*. But control and fruit fortified yoghurt were differ nonsignificantly (p<0.05).

As presented in Fig 1, non significant (p<0.05) difference was observed in Lactobacilli counts in control as well as polyphenol fortified dahi during storage period of 3 weeks. at refrigeration temperature. Lejko *et al.,* 2011 also observed that tea supplementation influenced the acidity and *Lactobacillus delbrueckii ssp. Bulgaricus* counts as compare to plain yoghurt.

Determination of *Lactococci* counts during storage

Lactococci counts were observed to be stable upto 7 days in control and polyphenol fortified dahi as presented in Fig 2 and one log reduction was observed towards the end of storage period. There was non significant (p>0.05) difference in *lactococci* counts of control and polyphenol fortified dahi.

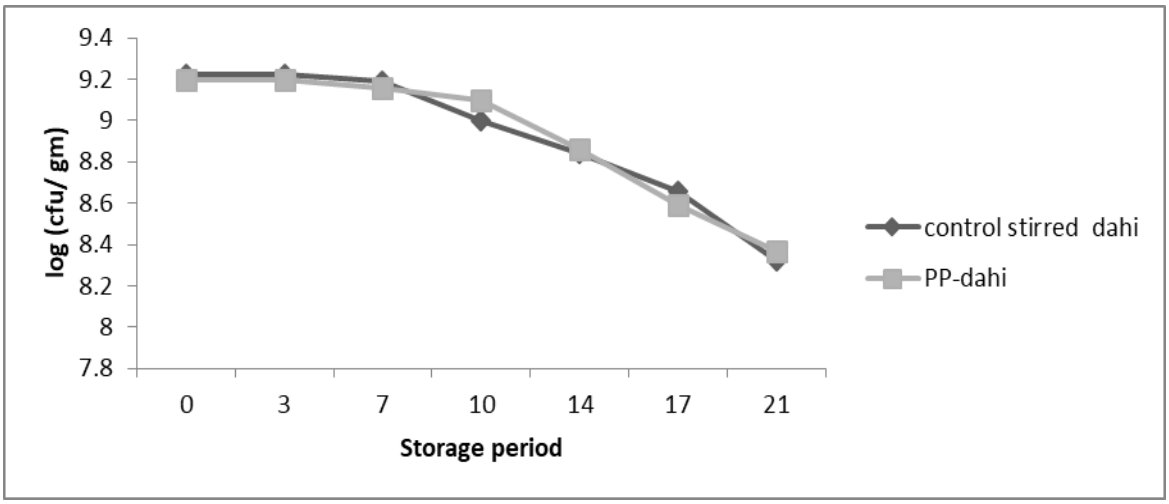

Fig 2: *Lactococci* counts of control and polyphenols fortified dahi during storage

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