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Quality of flavoured egg drink under refrigeration storage

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Abstract

The present study was conducted to evaluate the shelf life qualities of flavoured egg drinks bottled in polyethylene terephthalate (PET) bottle and stored under refrigeration temperature(4±1°C). During storage study, samples were evaluated for pH, titratable acidity, specific gravity, total solids, microbiological quality and sensory profiles at three days interval up to 15 days of storage period. Control had significantly (p<0.01) higher pH and lower titratable acidity compared to standardised flavoured egg drinks. The pH values of control and treatments increased up to the ninth day of storage and then declined whereas the mean titratable acidity values decreased from initial value up to ninth day and thereafter increased on 15th day of storage. Storage conditions had no noticeable effect on the total solid values and the control drink had significantly (p<0.01) higher total solids than the standardised flavoured egg drinks. There was no significant difference in specific gravity up to sixth day of storage among control and standardised flavoured egg drinks, thereafter from ninth to 15th day control had significantly (p<0.01) higher specific gravity than standardised flavoured egg drinks. There was significant (p<0.01) increase in total viable count throughout the storage period. Yeast and mould and psychrotrophic counts were not detected up to 15 days of storage. Standardised flavoured egg drink showed a higher acceptable sensory score than control throughout the storage period.

Keywords: *Flavoured egg drink, shelf life, microbial count, sensory profile*

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The Indian poultry industry portraits one of the most impressive success stories in Indian agricultural sector in modern times. According to FAO statistics (2019), India ranks third in egg production in the world and egg production in the country has increased from 78.48 billion in 2014-15 to 122.11 billion in 2020-21. Eggs are highly nutritious foods that are rich in bioavailable iron, zinc, iodine, vitamins A and B_{12}, choline and essential fatty acids. Chicken egg, being a source of animal protein in almost every nook and corner of the globe, has significant position in human nutrition as a source of highly digestible protein (Morris *et al.,* 2018). According to Lechevalier *et al*. (2011), egg product industry developed concomitantly with the food industry to provide food manufacturers with safe and ready-to-use egg products. Pasteurised whole egg, egg yolk and egg white are thus proposed either in liquid, frozen or powder forms. Worldwide demand for ready-to-drink food items such as flavoured drinks have been increased as a result of rising urbanisation and changing lifestyles.

One such alternative is a flavoured egg drink, a value-added product incorporating suitable non-calorific sweetener and flavouring agents, which is highly palatable, economical and convenient to use. Egg drink, especially with milk and flavour can bring a new dimension to food preparation and marketing. Egg drink is a kind of convenient product, valuable due to its high protein content, low cost and its use as a ready-to-drink product. Non-calorific sweeteners can be used as a means of controlling weight gain and diabetes, by retaining sweetness without increasing calorie intake. The addition of different flavours will provide characteristic flavour, intensify food quality and increase consumer demand.

The shelf life of a product is affected by several factors, including the ingredients used, manufacturing process, type of packaging, and storage conditions (Teixido *et al.,* 2022). It is essential to study the stability of flavour incorporated egg drink under refrigeration condition in order to determine its shelf stability because egg and milk-based products are prone to oxidation deterioration and faster microbial spoilage.

The objective of the study was to evaluate the shelf life qualities such as pH, titratable acidity, total solids, specific gravity, microbial quality and sensory attributes of the flavoured egg drink under refrigeration storage (4±1°C) for 15 days.

Materials and methods

This study was carried out at Department of Livestock Products Technology (Meat Technology unit), College of Veterinary and Animal Sciences, Mannuthy, Thrissur, Kerala. Fresh eggs were procured from Salmonella free stock maintained at All India Coordinated Research Project on Poultry (AICRP), Mannuthy. Pasteurised toned milk (Milma, Kerala Co-operative Milk Marketing Federation) was used throughout the study. Other ingredients like sweeteners, flavours and preservatives were procured from local markets and standard firms. Egg drink was developed and standardised using ingredients like egg, toned milk, non-calorific sweetener (stevia), flavours (mango and pineapple) and food grade preservatives.

The control egg drink C (with 8 per cent sucrose, but without non-calorific sweetener and flavour) and standardised products T_1 (with 2 per cent stevia sweetener and 2 per cent mango flavour) and T_2 (with 2 per cent stevia sweetener and 2 per cent pineapple flavour) were bottled in food grade polyethylene terephthalate bottles (PET) and stored under refrigeration condition (4±1°C) for shelf-life studies. pH, titratable acidity, total solids, specific gravity, microbial quality and sensory attributes of the products were evaluated on 0^{th}, 3^{rd}, 6^{th}, 9^{th}, 12^{th} and 15^{th} day of storage.

The pH of the flavoured egg drink was determined as per AOAC (2016). Twenty millilitres of sample were taken in a beaker and pH was measured by using the combined electrode digital pH meter (μ pH system 362, Systronics, India). Titratable acidity of flavoured egg drink sample was determined as per AOAC (2016) and expressed as lactic acid per 100 mL of flavoured egg drink. Total solids were determined by the method of ISO: 6732/1981. Specific gravity bottle method was used to determine the specific gravity.

The samples were homogenised with peptone water in a Stomacher (Seward Stomacher 400 Circulator) for the estimation of total viable count (TVC), psychrotrophic count and yeast and mould in the egg drink. Total viable count of aerobic bacteria of each sample was estimated by pour plate method, as described by Morton (2001) using standard plate count agar (HiMedia, Mumbai) and incubated at 37°C for 48 hours and the count expressed as $\log_{10}$ CFU/mL. Psychrotrophic count was assessed as per Cousin *et al.* (2001) using standard plate count agar (HiMedia, Mumbai) and incubated at 7°C for 10 days and the count was expressed as $\log_{10}$ CFU/mL. Method described by Beuchat and Cousin (2001) was followed for the estimation of yeast and mould count per millilitre of the sample. Sabouraud Dextrose Agar (HiMedia, Mumbai) was used. The plates were incubated at 25-27°C for three days and the count was expressed as $\log_{10}$ CFU/mL

Sensory evaluations were carried out by semi-trained panel consisting of seven panellists drawn from the Department of Poultry Science and Department of Livestock Products Technology, College of Veterinary and Animal Sciences, Mannuthy, Thrissur using an eight-point hedonic score card. The egg drinks were analysed for appearance and colour, flavour, sweetness, consistency, mouth coating, after taste and overall acceptability.

The data obtained from the current study were assessed statistically by repeated measures ANOVA, one way ANOVA and Friedmann test using the SPSS software version 24.0.

Results and discussion

Effect of storage days on pH of the control and flavoured egg drink is presented in Table 1. The pH values of control, T_1 and T_2 ranged from 6.89-7.07, 6.38-6.77 and 6.71-6.90 respectively during the storage period. The pH values of control and treatment groups increased up to ninth day of storage and thereafter decreased. Significantly ($p<0.01$) higher pH was observed for control, T_1 and T_2 on ninth day compared to all other days. The pH drop in the final days of storage might be attributed to the development of lactic acid by the microbial action. A similar trend of decrease in pH was recorded by Junaid *et al* (2013) in pineapple and mango flavoured milk drinks. Control had significantly ($p<0.01$) higher pH compared to T_1 and T_2 throughout the storage and this might be due to the effect produced by the added flavour in the flavoured egg drink. Similar observations were made by Dhamsaniya and Varshney (2013) who observed that pH of whey beverage was decreased remarkably from 4.74 to 4.37 with the increase in concentration of banana flavour.

Titratable acidity values (Table 2) of control, T_1 and T_2 on the day of preparation was 0.17, 0.23 and 0.24, respectively and it increased to 0.21, 0.30 and 0.27, respectively on 15th day of storage and it was reflected in the pH also. The mean titratable acidity values of control, T_1 and T_2 decreased from initial value up to 9th day and thereafter increased on 12th and 15th day of storage. Increase in titratable acidity might be due to the increase in growth of lactic acid bacteria during storage and the conversion of milk lactose into lactic acid and result was in accordance with Bajwa and Mittal (2015) who observed an increase in titratable acidity to an undesirable level in mango flavoured drink after eight days of storage. Titratable acidity values of control were significantly ($p<0.01$) lower compared to T_1 and T_2 throughout the storage and this might be due to the effect produced by the added flavours. The results supported the findings of Sonwalkar *et al.* (2017) who observed a linear increase in the titratable acidity of flavoured milk with addition of jackfruit flavour.

Total solid is an important parameter for both fruit juices and fruit-based milk drinks since it influences both stability and sensory features. The total solid values of control, T_1 and T_2 were 22.24, 17.39 and 18.42, respectively on the day of preparation and the effect of storage days on total solids values are presented in Table 3. Among control, T_1 and T_2, control had significantly ($p<0.01$) higher total solids values on all days of storage. This might be due to the higher level of sweetener inclusion in control compared to standardised egg drinks. This was in accordance with Alizadeh *et al* (2014) and Bajwa and Mital (2015) who reported that, total solid content reduced when non-caloric

sweeteners were used to replace sucrose in fruit-based milk shake and ready to drink milk supplemented with mango pulp, respectively. T_2 had significantly ($p<0.01$) higher total solids than T_1 up to 6th day of storage period. Storage conditions had no significant impact on the total solid values for the control and treatments. Similar findings were reported by Imran-Al-Haq and Mohyuddin (1992) in mango flavoured drink, Chourasia (2011) in herbal flavoured milk, and Oo and Than (2019) in the pineapple and mango jam.

Specific gravity values of control, T_1 and T_2 ranged from 1.059-1.062, 1.044-1.047 and 1.046 -1.050, respectively and the effects of storage days on specific gravity are presented in Table 4. These results were in agreement with Hossin *et al* (2021) who found that specific gravity ranged from 1.05 to 1.063 in strawberry flavoured milk under refrigeration storage. Specific gravity values of control and T_1 significantly ($p<0.05$) differed from 0th day to 15th day, but T_2 did not show any significant difference in specific gravity values throughout the storage period. There was no significant difference among control, T_1 and T_2 in specific gravity up to 6th day of storage which was in accordance with Hossin *et al*. (2021) who reported that there was no significant difference for specific gravity in strawberry flavoured milk up to seven days of storage. Control had significantly ($p<0.01$) higher specific gravity than T_1 and T_2 from 6th to 15th day and similar decrease in specific gravity values in flavoured milk was reported by Jothylingam and Pugazhenthi (2013) in herbal flavoured milk drink during storage.

The effect of storage on total viable count is presented in Table 5. During storage study, the TVC of control egg drink increased from $\log_{10}$ 3.45 CFU /mL to 4.90 CFU/mL whereas for T_1 and T_2, it was increased from $\log_{10}$ 3.23 CFU /mL to 4.73 CFU/mL and $\log_{10}$ 3.24 CFU/mL to 4.76 CFU/mL, respectively. The TVC values obtained in this study was in the range reported by Parseelan *et al*. (2019) in various commercial flavoured milk drinks. There was a significant ($p<0.01$) increase in TVC among control, T_1 and T_2 throughout the storage. Similar findings were observed by Ajmi *et al*. (2022) in lutein incorporated Shrikhand. Silva and Abeyrathne (2014) also reported an increase in bacterial count during refrigeration storage in a high protein drink made using poultry eggs and milk powder. Control had significantly ($p<0.01$) higher TVC compared to T_1 and T_2 throughout the storage study which might be due to the potential antimicrobial effect of sweetener, stevia added in the standardised flavoured egg drinks. Similar findings were reported by Pina-Perez *et al.* (2018) and Ahmad *et al.* (2020) in stevia added dairy products.

Table 1. Effect of storage days on pH of flavoured egg drinks

Sample	0th day	3rd day	6th day	9th day	12th day	15thday	F value (p-value)
C	6.89 ± 0.02^{aD}	6.99 ± 0.01^{aC}	7.01 ± 0.02^{aB}	7.07 ± 0.25^{aA}	7.01 ± 0.05^{aB}	7.01 ± 0.05^{aB}	18.43** (0.001)
T_1	6.66 ± 0.02^{cC}	6.72 ± 0.01^{cB}	6.77 ± 0.02^{cA}	6.77 ± 0.02^{cA}	6.50 ± 0.04^{cD}	6.38 ± 0.05^{cE}	235.69** (0.001)
T_2	6.71 ± 0.02^{bD}	6.85 ± 0.01^{bB}	6.88 ± 0.02^{bB}	6.90 ± 0.02^{bA}	6.82 ± 0.05^{bC}	6.81 ± 0.05^{bC}	38.49** (0.001)
F value (p-value)	30.23** (0.001)	141.69** (0.001)	47.26** (0.001)	35.14** (0.001)	27.69** (0.001)	94.93** (0.001)	

** - significant at 1% level, No. of observations =24

C– Control (without non-calorific sugar and flavour, with sucrose)

T_1- standardised egg drink with stevia + mango flavour

T_2- standardised egg drink with stevia + pineapple flavour

Values are expressed as Mean ± standard error

Means with different lower case letters as superscripts are significantly different between C, T_1 and T_2. Means with different upper case letters are significantly different between storage days

Table 2. Effect of storage days on titratable acidity (per cent lactic acid) of flavoured egg drinks

Sample	0th day	3rd day	6th day	9th day	12th day	15thday	F value (p- value)
C	0.17±0.01^{bB}	0.16±0.01^{bB}	0.15±0.01^{cB}	0.16±0.01^{cB}	0.19±0.01^{cA}	0.21±0.0^{bA}	11.37** (0.001)
T_1	0.23±0.01^{aB}	0.19±0.01^{aC}	0.19±0.01^{bC}	0.19±0.01^{aC}	0.29±0.01^{bA}	0.30±0.02^{aA}	92.34** (0.001)
T_2	0.24±0.01^{aAB}	0.21±0.01^{bA}	0.22±0.01^{aB}	0.20±0.01^{aAC}	0.25±0.01^{bAB}	0.27±0.02^{bA}	8.37** (0.001)
F value (p- value)	7.18** (0.004)	23.61** (0.001)	67.00** (0.001)	79.52** (0.001)	78.58** (0.001)	3.78** (0.001)	

** - significant at 1 % level, No. of observations=24
C– Control (without non-calorific sugar and flavour, with sucrose)
T_1- standardised egg drink with stevia + mango flavour
T_2- standardised egg drink with stevia + pineapple flavour
Values are expressed as Mean ± standard error
Means with different lower case letters as superscripts are significantly different between C, T_1 and T_2.
Means with different upper case letters are significantly different between storage days

Table 3. Effect of storage days on total solids (per cent) of flavoured egg drinks

Sample	0th day	3rd day	6th day	9th day	12th day	15thday	F value (p-value)
C	22.24±0.20^{a}	21.73±0.59^{a}	20.76±0.32^{a}	23.15±0.50^{a}	23.03±0.32^{a}	23.20±0.47^{a}	5.52^{ns} (0.062)
T_1	17.39±0.19^{c}	17.45±0.59^{c}	18.14±0.32^{b}	18.61±0.50^{b}	19.04±0.32^{b}	18.40±47^{c}	3.54^{ns} (0.096)
T_2	18.42±0.19^{b}	19.76±0.59^{b}	19.11±0.32^{a}	19.80±0.50^{b}	19.57±0.32^{b}	20.75±0.47^{b}	4.45^{ns} (0.063)
F value (p-value)	182.18** (0.001)	13.30** (0.002)	17.50** (0.001)	21.87** (0.001)	46.38** (0.001)	25.62** (0.001)	

* - significant at 5 % level, ** - significant at 1% level, ^{ns}-non significant
No. of observations = 24
C– Control (without non-calorific sugar and flavour, with sucrose)
T_1- standardised egg drink with stevia + mango flavour
T_2- standardised egg drink with stevia + pineapple flavour
Values are expressed as Mean ± standard error
Means with different lower case letters as superscripts are significantly different between C_2, T_1 and T_2.
Means with different upper case letters are significantly different between storage periods.

Psychrotrophic, yeast and mould count were not detected in control, T_1 and T_2 throughout the storage period. This might be due to destruction by antifungal action of potassium sorbate and antimicrobial action of sodium benzoate added. Similar findings were reported by Mahato *et al*. (2022) who reported no growth of total psychrotrophic, total coliform, *E. coli*, and *L. monocytogenes* in chocolate flavoured milk till 28 days of storage. Absence of psychrotrophic count in the current study was in accordance with El-Shenawy (1988), who reported that lower temperatures enhanced antibacterial action of sodium benzoate.

The results pertaining to sensory evaluation of flavoured egg drink during storage at 4 ± 1°C are presented in Table 6. The sensory scores for attributes such as appearance and colour, flavour, after taste, mouth coating, smoothness and overall acceptability of both control and treatments declined with the progress of storage period.

Appearance and colour scores of control, T_1 and T_2 dropped from initial value of 6.98 to 5.78, 7.34 to 6.25 and 7.48 to 6.83, respectively during the storage period. T_1 and T_2 had significantly ($p<0.01$) higher score than control throughout the storage days. The flavour scores for C, T_1 and T_2 dropped from 6.96 to 5.75, 7.54 to 6.98 and 7.56 to 7.04, respectively. There was significant ($p<0.01$) difference between control, T_1 and T_2 for flavour scores throughout 15 days of storage. T_1 and T_2 had significantly ($p<0.01$) higher flavour score than C throughout the storage period. Increased bacterial growth towards the end of storage might be the reason for decreased sensory scores for colour and flavour and this

Table 4. Effect of storage days on specific gravity of flavoured egg drinks

Sample	0th day	3rd day	6th day	9th day	12th day	15thday	F value (p-value)
C	1.059±0.004^{B}	1.062±0.004^{B}	1.064±0.003^{aA}	1.075±0.002^{aA}	1.065±0.003^{aB}	1.062±0.001^{aB}	6.16* (0.035)
T_1	1.044±0.004^{B}	1.047±0.004^{B}	1.045±0.003^{bB}	1.059±0.002^{bA}	1.047±0.003^{bAB}	1.047±0.001^{bB}	6.06* (0.034)
T_2	1.046±0.004	1.047±0.004	1.047±0.003^{b}	1.056±0.002^{b}	1.050±0.003^{b}	1.050±0.001^{b}	1.84^{ns} (0.260)
F value (p- value)	3.89^{ns} (0.061)	3.99^{ns} (0.058)	13.38** (0.002)	28.46** (0.001)	14.31** (0.002)	60.61** (0.001)	

* - significant at 5% level, ** - significant at 1% level, ns – non significant
No. of observations =8
C– Control (without non-calorific sugar and flavour, with sucrose)
T_1- standardised egg drink with stevia + mango flavour
T_2- standardised egg drink with stevia + pineapple flavour
Values are expressed as Mean ± standard error
Means with different lower case letters as superscripts are significantly different between C, T_1 and T_2. Means with different upper case letters are significantly different between storage days

Table 5. Effect of storage days on TVC (CFU/mL) of flavoured egg drinks

Sample	0th day	3rd day	6th day	9th day	12th day	15thday	F value (p-value)
C	3.45±0.03^{Fa}	3.80±0.03^{aE}	4.12±0.03^{aD}	4.44±0.02^{aC}	4.49±0.01^{aB}	4.90±0.03^{aA}	444.71** (0.001)
T_1	3.23±0.03^{bF}	3.38±0.03^{bE}	3.87±0.03^{bD}	4.33±0.02^{bC}	4.41±0.01^{bB}	4.73±0.03^{bA}	525.64** (0.001)
T_2	3.24±0.03^{bF}	3.49±0.03^{bE}	3.86±0.03^{bD}	4.34±0.02^{bC}	4.42±0.01^{bB}	4.76±0.03^{bA}	528.18** (0.001)
F value (p-value)	20.90** (0.001)	38.00** (0.001)	26.63** (0.001)	16.24** (0.001)	23.86** (0.001)	8.06** (0.001)	

** - significant at 1 % level, No. of observations = 24
C– Control (without non-calorific sugar and flavour, with sucrose)
T_1- standardised egg drink with stevia + mango flavour
T_2- standardised egg drink with stevia + pineapple flavour
Values are expressed as Mean ± standard error
Means with different lower case letters as superscripts are significantly different between C, T_1 and T_2. Means with different upper case letters are significantly different between storage periods.

Table 6. Effect of storage days on sensory attributes of flavoured egg drinks

	Storage days						
	Day 0	**Day 3**	**Day 6**	**Day 9**	**Day 12**	**Day 15**	**χ^2 – value (p- value)**
	Appearance and Colour						
C	6.98±0.06^{bA}	6.92±0.04^{cA}	7.31±0.04^{aA}	7.04±0.05^{cA}	6.50±.06^{cB}	5.78±0.05^{cC}	79.60**(0.001)
T_1	7.34±0.08^{aA}	7.12±0.04^{bAB}	6.92±0.04^{bB}	7.08±0.02^{bA}	6.84±.05^{bB}	6.25±0.06^{bC}	76.552**(0.001)
T_2	7.48±0.06^{aAC}	7.46±0.07^{aAD}	7.33±0.05^{aA}	7.27±0.04^{aA}	7.18±.05^{aA}	6.83±0.05^{aB}	50.957**(0.001)
χ^2 – value (p- value)	22.14** (0.001)	30.99** (0.001)	33.09** (0.001)	34.35** (0.001)	37.85** (0.001)	51.66** (0.001)	
	Flavour						
C	6.96±0.03^{bAB}	6.92±0.04^{bAC}	6.71±0.08^{cAD}	6.47±0.06^{cA}	6.32±0.04^{bA}	5.75±0.07^{bB}	89.26**(0.001)
T_1	7.54±0.05^{aAC}	7.35±0.06^{aA}	7.14±0.05^{bAD}	6.99±0.04^{bB}	6.98±0.02^{aB}	7.00±0.0^{aB}	67.88**(0.001)
T_2	7.56±0.07^{aA}	7.44±0.07^{aA}	7.31±0.06^{aAB}	7.22±0.03^{aAB}	7.07±0.02^{aB}	7.04±0.01^{aB}	43.81**(0.001)
χ^2 – value (p- value)	43.26** (0.001)	30.36** (0.001)	30.31** (0.001)	46.28** (0.001)	55.86** (0.001)	62.83** (0.001)	
	After Taste						
C	7.24±0.04^{bAB}	7.09±0.03^{cAC}	7.03±0.02^{cA}	7.03±0.04^{aA}	6.73±0.05^{cB}	6.67±0.04^{bC}	82.02** (0.001)
T_1	7.44±0.02^{aAB}	7.30±0.04^{bAC}	7.17±0.04^{bA}	7.18±0.04^{bA}	6.91±0.04^{bB}	6.81±0.05^{aB}	87.45** (0.001)
T_2	7.55±0.04^{aAB}	7.44±0.03^{aAC}	7.31±0.03^{aAD}	7.31±0.04^{aA}	7.04±0.06^{aB}	6.92±0.03^{aB}	77.45** (0.001)
χ^2 – value (p- value)	24.29** (0.001)	33.04** (0.001)	25.64** (0.001)	25.64** (0.001)	17.53** (0.001)	13.95** (0.001)	
	Mouth Coating						
C	7.54±0.03^{bA}	7.38±0.06^{bA}	7.12±0.03^{bB}	7.03±0.02^{cB}	7.00±0.00^{bB}	6.15±0.05^{cC}	103.43** (0.001)
T_1	7.69±0.05^{aA}	7.50±0.05^{bA}	7.27±0.05^{bB}	7.16±0.03^{bB}	7.04±0.02^{bB}	6.83±0.05^{bC}	91.10**(0.001)
T_2	7.75±0.05^{aA}	7.70±0.06^{aA}	7.44±0.05^{aB}	7.34±0.04^{aB}	7.20±0.04^{aB}	7.08±0.04^{cA}	98.73**(0.001)
χ^2 – value (p- value)	7.43** (0.001)	16.39** (0.001)	18.75** (0.001)	31.30** (0.001)	26.17** (0.001)	54.75** (0.001)	
	Smoothness						
C	7.58±0.07^{bA}	7.54±0.08^{bA}	7.54±0.08^{bA}	7.27±0.04^{bB}	7.09±0.05^{bB}	6.52±0.06^{cC}	100.27**(0.001)
T_1	7.79±0.05^{abAB}	7.69±0.06^{aA}	7.69±0.06^{aA}	7.22±0.00^{bB}	7.00±0.00^{bB}	6.83±0.05^{bC}	107.24**(0.001)
T_2	7.83±0.05^{aA}	7.72±0.05^{aA}	7.73±0.05^{aA}	7.65±0.05^{aA}	7.31±0.05^{aB}	7.00±0.00^{aA}	100.28**(0.001)
χ^2 – value (p- value)	7.89** (0.001)	4.18** (0.001)	4.19** (0.001)	31.01** (0.001)	24.70** (0.001)	32.76** (0.001)	
	Overall acceptability						
C	7.65±0.05^{cA}	7.44±0.02^{cA}	7.35±0.04^{cA}	7.35±0.03^{bA}	7.05±0.02^{bB}	6.90±0.02^{bC}	107.04**(0.001)
T_1	7.79±0.05^{bA}	7.60±0.04^{bA}	7.43±0.03^{bAB}	7.43±0.04^{abAB}	7.16±0.05^{abB}	6.97±0.02^{Bc}	108.64**(0.001)
T_2	7.92±0.04^{aA}	7.79±0.05^{aA}	7.73±0.06^{aA}	7.73±0.03^{aA}	7.35±0.04^{aB}	7.05±0.08^{aB}	86.60**(0.001)
χ^2 – value (p- value)	14.19** (0.001)	26.11** (0.001)	22.11** (0.001)	22.11** (0.001)	22.11** (0.001)	22.11** (0.001)	

** - significant at 1 % level, No. of observations =28

C– Control (without non-calorific sugar and flavour, with sucrose)

T_1- standardised egg drink with stevia + mango flavour

T_2- standardised egg drink with stevia + pineapple flavour

Values are expressed as Mean ± standard error

Means with different lower case letters as superscripts are significantly different between C_2, T_1 and T_2. Means with different upper case letters are significantly different between storage days

was in accordance with Ahmed and Abdellatif (2013). Similar findings were reported by Junaid *et al*. (2013) who observed a decline in colour and flavour scores after six days of storage in flavoured probiotic milk.

There was no significant difference in after taste score for control, T_1 and T_2 up to ninth day of storage, thereafter score declined from day nine to 15. T_2 had significantly higher values for after taste up to day nine of storage when compared to control and T_1. Hossin *et al*. (2021) observed similar finding of decreasing after taste with increase in storage days in strawberry flavoured milk under refrigerated storage.

Control had significantly ($p<0.01$) lower values for mouth coating throughout the storage study. From the day of preparation to day 15, the mouth coating score of control, T_1 and T_2 decreased from 7.54, 7.69, 7.75 to 6.15, 6.83, 7.08, respectively. There was significant ($p< 0.01$) difference in the mouth coating values from day zero to day 15 for control and treatments. On the day of preparation smoothness score of control, T_1 and T_2 were 7.58, 7.79 and 7.83, respectively and on 15th day the scores reduced to 6.52, 6.83 and 7.00, respectively. T_2 had significantly ($p<0.01$) higher values throughout the storage study followed by T_1 and control. The mouth coating and smoothness scores were declined with increase in storage days and this was in accordance with Bajwa and Mittal (2015) in mango pulp supplemented ready to drink milk.

Overall acceptability scores of control, T_1 and T_2 dropped from 7.65 to 6.90, 7.79 to 6.97 and 7.92 to 7.05, respectively from the day of preparation to 15th day of storage. Overall acceptability scores significantly ($p< 0.01$) declined on the 12th day of storage for control and treatments. This might be due to the deterioration by microbes. The result was in agreement with Nedanovska *et al*. (2022) who noticed, that the overall acceptability of flavoured milk slightly declined on day nine, but significantly ($p<0.05$) decreased on the 15th day of storage. T_2 had significantly ($p<0.01$) higher values for overall acceptability throughout the storage period followed by T_1, then control. This might be due to better acceptance of pineapple flavour preference by the panellists.

Statistical evaluation revealed that standardised flavoured egg drinks (T_1 and T_2) had significantly ($p<0.01$) higher values for colour, flavour, after taste, mouth coating, smoothness and overall acceptability compared to control throughout the storage period. This might be due to the effect of added flavour and the result was in accordance with Singh *et al.* (2020).

Conclusion

The present study revealed that a shelf stable flavoured egg drink can be prepared by incorporating milk, egg, non-calorific sweetener and flavour. Developed product can be stored at refrigeration condition for 15 days without affecting its sensory qualities.

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Conflicts of interest

The authors declare that they have no conflict of interest.

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