



ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2021; 10(3): 290-293
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www.thepharmajournal.com
Received: 18-12-2020
Accepted: 05-02-2021

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Preparation of carbonated lemon whey beverage

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Abstract

The present study entitled “Preparation of carbonated lemon whey beverage” was carried out using different levels of lemon and sugar with a view to optimize the process for its manufacture and to study its chemical, sensory and microbiological qualities. Initially the preliminary trials were conducted by blending of different levels of lemon @ 4, 4.5, 5, and 5.5% in the lemon whey beverage with 8, 10, 12% sugar to finalize the experimental treatments. Experimental lemon whey beverage samples were analyzed for sensory, chemical and microbiological qualities.

It was observed that lemon whey beverage samples under different treatments showed significant differences for total solid, fat, protein, acidity, ash and moisture. The values were ranged from 5.73 to 6.29, 0.52 to 0.57, 0.52 to 0.53, and 0.79 to 0.87%, 0.39 to 0.41% and 93.71 to 94.27 respectively. Fat, total solid, protein, ash, acidity and moisture contents differed non-significantly among the different types of lemon whey beverage with lemon and sugar. Significant difference was observed within the smell and taste score and the consistency of different types of lemon whey beverage. In case of sensory evaluation, colour and appearance, consistency, overall acceptability found to be significant over the other treatments. The microbial results indicate that the standard plate count of lemon whey beverage was within the acceptable limit upto 7th day. The coliform count was not detected upto 15th days. It is concluded that addition of lemon and sugar @ 5.5 and 12 per cent, respectively, could be successfully utilized for the preparation of carbonated lemon whey beverage which improved its sensory, microbial and physicochemical characteristics.

Keywords: Lemon, whey, carbonation, beverage, microbial count and Physico-chemical quality

Introduction

Whey beverages have been recognizing as a genuine thirst quencher, light, refreshing, healthful and nutritious. Whey based fruits beverages are more suitable for health as compared to other drinks. Whey and its biological components have proven its effects in treatments of cervical chronic diseases like cancer, cardiovascular etc. It is nutritionally rich hence, it can also be used in beverages, infant, geriatric and athletic food (Patel *et.al*, 2017)^[13].

Many attempts have been done on utilization of whey in the formulation of various dairy products but, still there is a lot of scope to explore the possibilities for its utilization in beverage industries. Now a day's Indian dairy industries looking for new product ideas and technologies to meet the consumer's requirement and to increase the profitability of the dairy farmers. Product diversification is quite feasible using whey as water or fruit juice replacer without much change in the composition.

Whey is one of the major nutritious by-products obtained from the dairy industry producing cheese, channa and paneer. Composition and characteristics of whey varies depending on the applied production technology and the type of end product. Whey contains about 50% of the nutrients originally present in milk, comprising milk sugar (lactose), serum proteins (whey proteins), minerals, a small amount of fat and most of the water soluble minor nutrients from milk (vitamins).

The citrus fruits have long been valued as part of a nutritious and tasty diet. It is well established that citrus and citrus products are a rich source of vitamins, minerals and dietary fibre (non-starch polysaccharides) that are essential for normal growth and development and overall nutritional well-being.

Citrus is most commonly thought of as a good source of vitamin C. It is rich source of nutrients like calcium, potassium, vitamin C and protein fibre. It also has medicinal values and antibacterial properties. It also contains traces of iron and vitamin A. It helps cure the common cold. Lemon fruits was evaluated for the preparation of some new products, viz juice concentrate, foam mat dried juice power, carbonated beverage, powdered appetizer and drink.

Keith Singletar (2010)^[12] stated that the ginger may alleviate the symptoms of nausea and vomiting following pregnancy, surgery, cancer therapy, or motion sickness and suggestive evidence that ginger reduces inflammation and pain.

Based on evidence primarily from animal and *in vitro* studies, ginger may have beneficial effects toward cardiovascular disease through its multiple actions counteracting inflammation, hyperlipidaemia, platelet aggregation, and hypertension. Ginger can treat many forms of nausea, especially morning sickness. Ginger may reduce muscle pain and soreness. The anti-inflammatory effects can help with osteoarthritis. Ginger can help treat chronic indigestion. Ginger may lower cholesterol level. Ginger is effective in the treatment of cough and cold. It has been used to treat intestinal infections, especially related with digestive problems. The study aims at developing technology for better utilization of lemon and ginger juice in the preparation of carbonated whey beverage.

Material and Methods

The study was carried out at the Department of Animal Biotechnology, Collage of Agricultural Biotechnology, Loni. The fresh whey was obtained from the Satral Dairy, Satral Tal- Rahuri Dist- Ahmednagar (MS). The fresh lemons and gingers were obtained from Krishna farm, Pathare Tal- Rahata Dist-Ahmednagar (MS). Ingredients like sugar, salt was purchased from the local market.

Physico-Chemical Analysis

The total solid content of whey, lemon juice and ginger juice and carbonated lemon whey beverage were determined by gravimetric method as per IS: 1479 (part II), 1961^[10]. The fat content was determined by using standard Gerber method as described in IS: 1224 (part II), 1977. The protein content was determined by estimating the per cent nitrogen by Micro-kjeldhal method as recommended in IS: 1479 (part II), 1961^[10]. The per cent nitrogen was multiplied by 6.38 to find out protein percentage in whey. Per cent ash content was determined by the method described in A.O.A.C., 1975. Per cent moisture content was determined by gravimetric method as per IS: 1479 (part II) 1961^[10]. The acidity of whey expressed as per cent lactic acid was determined by the method described in IS: 1479 (part I), 1960^[9].

Sensory Evaluation

The fresh sample of whey beverage were evaluated organoleptically by nine point hedonic scale for various quality attributes such as general appearance, body, texture and flavour by panel of 8-10 judges. The experimental samples were served to the judges at 7°C. The panelists were instructed to rate each sample on 9 point hedonic scale. They were provided hedonic scale score cards for evaluating the quality of product as described in ARE: 6273 (part-II) 1971^[11].

Microbiological Analysis

All the treatment samples of carbonated lemon whey beverage along with control sample were stored at 4°C and analysed for different microbial parameters such as standard plate count, coli form count, yeast and mould count by adopting standard procedure throughout the storage period.

Statistical Analysis

For present investigation FCRD i.e. Factorial Completely

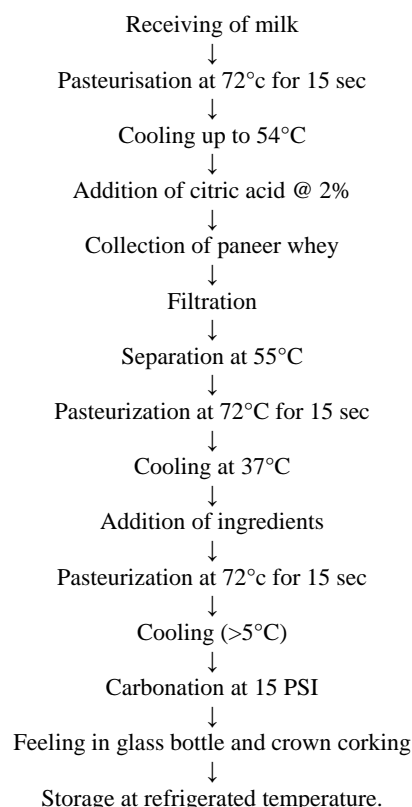
Randomised Design was employed using three replications. The data were tabulated and analysed according to Snedecor and Cochran (1994).

Treatments

Preliminary trials were conducted to find out the blending of lemon and sugar along with ginger and salt to have proper aroma and consistency. After trying different levels of lemon and sugar the following proportion were finalized for study.

Sr. No.	Treatments	Lemon (%)	Sugar (%)	Ginger (%)	Salt (%)
1	L ₁ S ₁	4	8	1.0	0.6
2	L ₁ S ₂	4	10	1.0	0.6
3	L ₁ S ₃	4	12	1.0	0.6
4	L ₂ S ₁	4.5	8	1.0	0.6
5	L ₂ S ₂	4.5	10	1.0	0.6
6	L ₂ S ₃	4.5	12	1.0	0.6
7	L ₃ S ₁	5	8	1.0	0.6
8	L ₃ S ₂	5	10	1.0	0.6
9	L ₃ S ₃	5	12	1.0	0.6
10	L ₄ S ₁	5.5	8	1.0	0.6
11	L ₄ S ₂	5.5	10	1.0	0.6
12	L ₄ S ₃	5.5	12	1.0	0.6

Flow diagram for preparation of carbonated lemon whey beverage



Results and discussion

Table 1: Chemical analysis of cow milk

Sr. No.	Constituents	Cow milk (%)	Chhana whey	Lemon	Ginger
1	Total Solid	12.93	6.38	7.21	24.92
2	Fat	4.20	0.54	0.84	5.03
3	Protein	3.04	0.46	1.22	4.88
4	Ash	0.62	0.42	0.38	1.74
5	Acidity	0.13	0.78	3.81	0.43
6	pH	6.4	5.74	2.82	6.40

It is clear from the figure of total solids, fat, protein and acidity that they within the limits of standards of cow milk in Maharashtra state as prescribed by PFA rules, 1976 cited by De (2008) [5]. The results presented in showed that the whey used for preparation of lemon whey beverage had on average value for total solids 6.38, fat 0.54, protein 0.46, ash 0.42, acidity 0.78 and pH 5.74. Lemon and ginger used for preparation of carbonated whey beverage had on average value for total solid 7.21 and 24.92, fat 0.84 and 5.03, protein 1.22 and 4.88, ash 0.38 and 1.74, pH 2.82 and 6.40, moisture 89.16 and 75.08 and acidity 3.81 and 0.43, respectively.

Table 2: Effect of different levels of lemon and sugar on composition of lemon whey beverage (per cent)

Particulars	L1	L2	L3	L4	Mean
Total solids (%)					
S ₁	6.14 ^{ab}	6.19 ^{ab}	6.29 ^a	6.14 ^{ab}	6.19
S ₂	6.09 ^{bc}	6.11 ^{bc}	5.97 ^d	6.13 ^b	6.08
S ₃	5.95 ^d	5.94 ^d	6.01 ^{cd}	5.73 ^e	5.91
Mean	6.06	6.08	6.09	6.00	6.06
CD (0.05)	L = NS, S = 0.10, L × S = NS, CV% = 2.02				
Fat (%)					
S ₁	0.56 ^{ab}	0.56 ^{ab}	0.56 ^{ab}	0.57 ^a	0.56
S ₂	0.53 ^{de}	0.55 ^{bc}	0.54 ^{cd}	0.54 ^{cd}	0.54
S ₃	0.52 ^e	0.54 ^{cd}	0.52 ^e	0.54 ^{cd}	0.53
Mean	0.54	0.55	0.54	0.55	0.54
CD (0.05)	L = 0.01, S = NS, L × S = NS, CV% = 1.51				
Protein (%)					
S ₁	0.50 ^b	0.47 ^d	0.53 ^a	0.53 ^a	0.51
S ₂	0.48 ^{cd}	0.50 ^b	0.52 ^a	0.52 ^a	0.50
S ₃	0.48 ^{cd}	0.48 ^{cd}	0.50 ^b	0.52 ^a	0.50
Mean	0.49	0.48	0.52	0.52	0.50
CD (0.05)	L = NS, S = NS, L × S = NS, CV% = 3.07				
Ash (%)					
S ₁	0.41 ^a	0.41 ^a	0.41 ^a	0.41 ^a	0.41
S ₂	0.39 ^c	0.39 ^c	0.40 ^b	0.40 ^b	0.40
S ₃	0.39 ^c	0.40 ^b	0.39 ^c	0.39 ^c	0.39
Mean	0.40	0.40	0.40	0.40	0.40
CD (0.05)	L = 0.00, S = NS, L × S = S, CV% = 1.49				
Acidity (%)					
S ₁	0.83 ^{de}	0.85 ^{bc}	0.87 ^a	0.87 ^a	0.85
S ₂	0.82 ^{ef}	0.84 ^{cd}	0.85 ^{bc}	0.86 ^{ab}	0.84
S ₃	0.79 ^g	0.81 ^f	0.83 ^{de}	0.86 ^{ab}	0.83
Mean	0.81	0.83	0.85	0.86	0.84
CD (0.05)	L = 0.01, S = 0.01, L × S = NS, CV% = 0.89				
Moisture (%)					
S ₁	93.86 ^d	93.81 ^{de}	93.71 ^e	93.86 ^d	93.81
S ₂	93.91 ^{cd}	93.89 ^{cd}	94.03 ^b	93.87 ^d	93.92
S ₃	94.05 ^b	94.06 ^b	93.99 ^{bd}	94.27	94.10
Mean	93.94	93.92	93.91	94.00	93.94
CD (0.05)	L = 0.10, S = NS, L × S = NS, CV% = 0.13				

Note: Each observation is a mean ± SD of three replicate experiments (n=3)

The perusal of data from Table 2 revealed that blending with lemon and sugar had non-significant effect on the total solid, fat, protein, ash content of lemon whey beverage. It was observed that blending of lemon and sugar decreased the total

solid, fat content of lemon whey beverage.

Blending with lemon and sugar had non- significantly affected the acidity and moisture content of lemon whey beverage. It was observed that blending of lemon and sugar increased the acidity and moisture content of lemon whey beverage

Table 3: Effect of lemon juice and sugar addition on sensory characteristics of whey beverage

Particulars	L1	L2	L3	L4	Mean
Colour and appearance					
S ₁	7.23 ⁱ	7.50 ^e	7.40 ^{hg}	7.63 ^d	7.44
S ₂	7.27 ^{hi}	7.33 ^{gh}	7.60 ^d	7.73 ^c	7.48
S ₃	7.27 ^{hi}	7.43 ^{ef}	8.13 ^b	8.23 ^a	7.77
Mean	7.26	7.42	7.71	7.87	7.56
CD (0.05)	L = 0.07, S = 0.14, L × S = ---, CV% = 1.15				
Consistency					
S ₁	7.23 ^g	7.53 ^d	7.50 ^{de}	7.57 ^d	7.46
S ₂	7.13 ^h	7.33 ^f	7.73 ^c	7.73 ^c	7.48
S ₃	7.20 ^{gh}	7.43 ^e	8.17 ^b	8.43 ^a	7.81
Mean	7.19	7.43	7.80	7.91	7.58
CD (0.05)	L = 0.06, S = 0.12, L × S = NS, CV% = 0.94				
Flavour					
S ₁	7.13 ^f	7.27 ^e	7.47 ^d	7.47 ^d	7.33
S ₂	7.10 ^f	7.30 ^e	7.60 ^c	7.57 ^c	7.39
S ₃	7.23 ^e	7.43 ^d	8.27 ^b	8.47 ^a	7.85
Mean	7.16	7.33	7.78	7.83	7.53
CD (0.05)	L = 0.06, S = 0.12, L × S = NS, CV% = 0.93				
Overall acceptability					
S ₁	7.20 ^{gh}	7.43 ^e	7.46 ^e	7.56 ^d	7.41
S ₂	7.17 ^h	7.32 ^f	7.64 ^c	7.68 ^c	7.45
S ₃	7.23 ^e	7.43 ^e	8.19 ^b	8.38 ^a	7.81
Mean	7.20	7.40	7.76	7.87	7.56
CD (0.05)	L = 0.04, S = 0.09, L × S = NS, CV% = 0.71				

The highest score (8.23) for colour and appearance was obtained by the treatment L₄S₃ i.e. lemon whey beverage with 5.5% lemon and 12% sugar. Lowest score (7.23) was observed for treatment L₁S₁ i.e. lemon whey beverage with 4% lemon and 8% sugar.

Similarly, the highest score (8.43) for consistency was obtained by the treatment L₄S₃ i.e. lemon whey beverage with 5.5% lemon and 12% sugar. Lowest score (7.13) was observed for treatment L₁S₂ i.e. lemon whey beverage with 4% lemon and 10% sugar. The perusal of data from table showed that the score for flavour was increased due to increase of lemon and sugar. The highest score (8.47) was obtained by the treatment L₄S₃ i.e. lemon whey beverage with 5.5% lemon and 12% sugar. Lowest score (7.13) was observed for treatment L₁S₂ i.e. lemon whey beverage with 4% lemon and 10% sugar. From overall acceptability scores, it is clear that lemon whey beverage prepared from 5.5% lemon and 12% sugar recorded highest value (8.38) in treatment combination L₄S₃ for overall acceptability where as it was recorded lowest (7.17) in L₁S₂ prepared from 4.0 % lemon and 10% sugar.

Table 4: Changes in microbial qualities of carbonated lemon whey beverage during storage

Storage period (days) Attributes	0	7	14	21	28	SEm	C.D. (0.05)	C.V. (%)
Standard Plate Count (log cfu/ml)	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.26 ± 0.08	0.024	0.082	10.26
Yeast and Mold Count (cfu/ml)	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.09 ± 0.01	0.157	0.354	20.14
E. Coli Count (cfu/ml)	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.01	0.01	6.14

Note: Each observation is a mean ± SD of three replicate experiments (n=3)

There was no growth during first 21 days of storage. As the storage days increases from 21 days to 28 days the SPC increase to 0.26 log cfu/ml. As the storage period advanced, the SPC increased after 21 days at each stage during storage. On the production day and up to 21 days of storage, the whey beverage showed no growth of yeast and mold. During the period of storage the yeast and mould count of whey beverage increased after 21 days and reached 0.09 cfu/ml on 28 days of storage. Whey beverage samples stored at refrigerated temperature were found to be free from coliform throughout the storage study.

Production cost of lemon whey beverage

The production cost of carbonated lemon whey beverage was worked out by considering the prevailing retail cost of ingredient only. Increased in the level of lemon and sugar were observed to be increased in the production cost of lemon whey beverage. Cost of lemon whey beverage production of L₁S₁, L₁S₂, L₁S₃, L₂S₁, L₂S₂, L₂S₃, L₃S₁, L₃S₂, L₃S₃, L₄S₁, L₄S₂ and L₄S₃ level was Rupees 35.35, 35.95, 36.60, 36.30, 36.95, 37.60, 37.30, 37.90, 38.55, 38.25, 38.90 and 39.55 per lit, respectively. The production cost of lemon whey beverage of most acceptable level i.e. L₄S₃ was Rupees 39.55 per lit.

Conclusion

It may be concluded that the Lemon and sugar could be successfully utilized for the preparation of lemon whey beverage. The most acceptable quality of lemon whey beverage can be prepared by using 5.5% lemon and 12% sugar. Addition of lemon juice improves the sensory quality and acceptability of lemon whey beverage. For the incorporation into lemon whey beverage optimum level of lemon juice should be 5.5% level. The production cost of most acceptable quality of lemon whey beverage (L₄S₃) was 39.55 per lit.

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