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Preparation and Quality Evaluation of Orange Incorporated *Paneer* Whey- Lemon Beverage

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ABSTRACT

The main objective of this study was to utilize the *paneer* whey for the preparation of beverage. For this purpose, orange juice, lemon juice and *paneer* whey (obtained by 2% citric acid coagulation) were prepared. After screening experimental beverages made using mixture design by sensory analysis, a control sample and four different samples were prepared, varying proportion of whey and orange juice, while keeping lemon juice and sugar content at fixed level of 1% v/v and 8% w/v, respectively. Then, the whole mix was heated at 88ºC for 15 minutes, after filling in glass bottles, then cooled to room temperature at 25±5ºC and were subjected to sensory evaluation and chemical analysis. The best beverage formulation was determined from higher sensory score and higher ascorbic acid content and stored at refrigeration temperature 6±1ºC. The ascorbic acid content of the four beverage formulations prepared by varying orange juice at the level 10% (sample A), 12.5% (sample B), 15% (sample C) ,17.5% (sample D) and control sample E (0% orange juice) was determined. Statistically there was no significant difference ($p \leq 0.05$) in between the samples C and D with respect to ascorbic acid content. From 9-point hedonic rating sensory analysis, the best formulated orange incorporated *paneer* whey-lemon beverage sample was found to be sample C having 76% whey, 15% orange juice, 1% lemon juice and 8% sugar. The TSS, pH, acidity, reducing sugar, total sugar, and ascorbic acid content of this optimized beverage sample was found to be 12 ± 0.1 ºBx, 4.35 ± 0.05, 0.40 ± 0.01%, 5.04 ± 0.07%,11.65 ± 0.24% and 4.58 ± 0.51 mg/ 100 ml, respectively.

Key words: paneer whey, beverage, ascorbic acid, sensory analysis

Introduction

Whey is the largest and highly nutritious by-product obtained during manufacture of cheese, *chhanna* and *paneer*. Whey contains about 50% of the nutrients originally present in milk, comprising milk sugar (lactose), serum proteins (whey proteins), minerals and a small amount of fat and most of water soluble minor nutrients from milk (vitamins). Whey is an excellent source of high biological value protein which is complete, high quality protein with a rich amino acid profile. Whey contains many organic and inorganic components which can replace the much of loss of electrolytes, vitamins, amino acids and other organic components (Patel, 2017).

The conversion of whey into beverage through fermentation or without fermentation is one of the most attractive avenues for utilizing whey for human consumption. In whey beverage, a certain amount of lactose is being transformed to lactic acid which gives a refreshing sour taste to the end product (Jelicic *et al.,* 2008). Besides being delicious, these beverages are highly nutritious in terms of functionality. Whey proteins enhance protein content of beverage while improving its quality (Chavan *et al.,* 2015). The overall acceptability of whey based fruit beverages can be upto 15 days at refrigeration temperature (Yadav *et al.,* 2010).

All citrus fruits belong to a single genus, Citrus, and are well known for their refreshing and thirst quenching ability and providing adequate vitamin C as per recommended daily dietary allowance (Ladaniya, 2008). Citrus fruits, especially lemon and orange have many health proven benefits as they are biologically active, and many non-nutritious compounds found in citrus fruits, such as phyto-chemicals, anti-oxidants, and soluble as well as non-soluble dietary fiber are helpful in reducing the risk for cancers, and many other chronic diseases like arthritis, obesity and coronary heart disease (Anon, 2018). Fruits and their juices have been increasingly considered as a part of a healthy diet (Niva, 2007).

Lemon (*Citrus lemon*), is a species of small evergreen tree in the flowering plant family Rutaceae, native to Asia. The juice of the lemon contains about 5 to 6%

citric acid, with pH around 2.2, giving it a sour taste. The distinctive sour taste of lemon juice makes it a key ingredient in drinks and foods such as lemonade and lemon meringue. Orange (*Citrus sinensis*), is a species of the family Rutaceae, also called sweet orange to distinguish it from the related *Citrus aurantium*, which is referred to as bitter orange. Sweet orange is a rich source of many vitamins, minerals, digestible carbohydrates and organic acids, which stimulates appetite and help to proper digestion of foods. Vitamin C is a potent antioxidant, protecting cells by scavenging and neutralizing harmful free radicals (Selvaraj and Sarathchandra, 2018).

Materials and Methods

Raw materials used were *paneer* whey obtained by 2% citric acid coagulation of standard market milk (Awsi and Darcus, 2012), orange juice, lemon juice and granulated sugar. The lemon (*Citrus limon*) and well ripened sweet orange (*Citrus sinensis* var *mandarin*) of good quality were procured from local market of Biratnagar for the extraction of juice. Fine crystalline cane sugar of commercial grade was obtained from local market of Biratnagar. Glass bottles of 200 ml capacity were obtained from the market of Biratnagar and were thoroughly cleaned with cold water and detergent, followed by hot water. All chemicals and glasswares, were available in the laboratory of Birat Multiple College, Biratnagar. All the reagents and chemicals were of analytical grade.

Preparation of orange incorporated whey-lemon beverage

The lemon juice was prepared from matured and unbruished lemon. The fruits were washed thoroughly under tap water for sanitation and then it was wiped with a clean sterile muslin cloth and kept in proper dry place under room temperature. After washing, fruits were cut into two halves by a knife and seeds were removed, juice was extracted by squeezing lemon by lemon squeezer and was filtered through muslin cloth. The juice was stored under refrigerated condition (6±1 ºC) for further use. Similarly, for orange juice, the outer skin was peeled off, seeds were removed and only inner juicy portion of the fruits was utilized for juice extraction. The juicy portion was placed into blender and the juice was extracted. The extracted juice was filtered through muslin cloth to remove must and to get clear juice.

The different beverage formulations were prepared in triplicates using mixture design of Design-Expert® version 7 and finally by sensory analysis, 100 ml product- orange incorporated *paneer* whey-lemon beverages coded A, B, C, D and control E were made, taking respective amount of orange juice (10%, 12.5%, 15% and 17.5%, 0%), whey (81%, 78.5%, 76%, 73.5%, 91%), fixing amount of sugar, and lemon juice at 8% and 1%, respectively, as shown in Table 1. *Paneer* whey was heated around 45ºC to dissolve sugar (8% w/v) in it and the whey was used for remaining volume make up of beverage to 100 ml. Then, juice was mixed up with the above mixture and the whole mixture was subjected to filtration through muslin cloth. After filtration, the beverages were filled in the 150 ml glass bottles and then sealed by crown corking and heat treated, i.e. in-bottle pasteurization (88 °C/15 min) and then finally cooled to room temperature at 25±5 °C (Bohara, 2017).

Table 1. Different recipe of orange incorporated *paneer* whey-lemon beverage samples

Sample Code	*Paneer* whey (ml)	Sugar (g)	Orange Juice (ml)	Lemon Juice (ml)
A	81	8	10	1
B	78.5	8	12.5	1
C	76	8	15	1
D	73.5	8	17.5	1
E	91	8	0	1

Determination of pH, total soluble solids (TSS), reducing sugar and total sugar

The pH was determined using digital HANNA pocket sized pH meter of range 0.0-14.0 pH having accuracy ±0.1 pH. The pH meter was calibrated using analytical grade buffer solution of pH 4.0, 7.0 and 9.0 (Ranganna, 1986). The total soluble solid content (TSS) was determined using ERMA hand refractometer (of range 0-32 ºBx) having Built-in-Automatic Temperature Compensation System (Ranganna, 1986). The total sugar and reducing sugar content was determined by Lane and Eynon method as given by Ranganna (1986).

Determination of fat content

The fat content of *paneer* whey and prepared beverages was determined by Gerber centrifuge method as given by Kharel (1999).

Determination of protein

The protein content was determined by Kjeldahl method (Ranganna, 1986).

Determination of acidity

The acidity was determined by titrating with alkali (NaOH) using phenophthalein indicator as adopting a

method given by AOAC (2007) and expressed as % Lactic acid for *paneer* whey and % citric acid for juices.

Determination of ascorbic acid content

The amount of ascorbic acid in juice was determined using a method as given by Rangana (1986) by titrating a known volume of samples with 2, 6-dichlorophenol indophenols dye, using metaphosphoric acid as a stabilizer. The ascorbic acid content was determined as:

$$\text{Ascorbic acid (mg/100g)} = \frac{(\text{Titer} \times \text{Volume made up} \times 100)}{(\text{Aliquot} \times \text{Volume of sample})}$$

Determination of ash content and moisture content

The ash content of raw materials and the beverages were determined by dry ashing method using muffle furnace (Ranganna, 1986). The moisture content was determined by Hot air oven method as per Ranganna (1986).

Sensory quality evaluation

Evaluation of sensory characteristics was performed for the optimization of ingredients by panel of 10 semi-trained panelists/judges using 9-point hedonic scale (Ranganna, 1986).

Statistical analysis

This experiment was conducted in triplicates and GenStat Discovery, developed by Lawes Agricultural Trust (1995) was used for statistical data analysis at 5% level of significance. The means were compared using LSD test, ANOVA (No blocking at 5% level of significance) and interaction effects used to determine whether the samples were significantly different from each other.

Results and Discussion

In the preparation of beverages, *paneer* whey, orange juice and lemon juice were the major ingredients which were analyzed for their chemical composition presented in Table 1.

Table 1. Composition of orange juice, lemon juice and *paneer* whey (in dry basis)

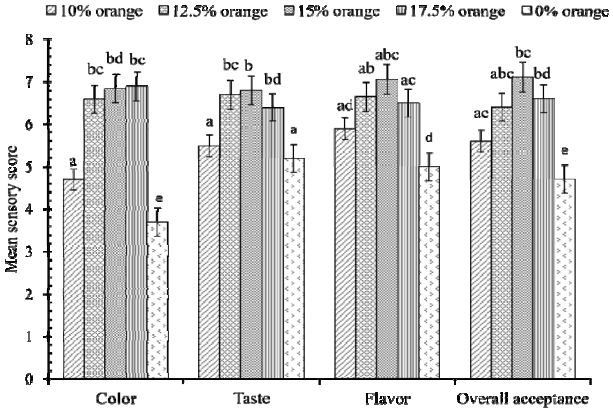
Parameters	Orange Juice	Lemon Juice	*Paneer* Whey
TSS (° Bx)	10.50 (0.1)	5.75 (0.057)	5.40 (0.1)
Moisture (%)	88.27 (0.02)	91.51 (0.15)	93.76 (0.09)
pH	4.03 (0.05)	2.3 (0.1)	4.90 (0.1)
Acidity (%)	0.56 (0.01)	5.12 (0.01)	0.25 (0.02)
Reducing sugar (%)	6.63 (0.42)	-	4.34 (0.35)
Total sugar (%)	10.02 (0.69)	-	5.07 (0.27)
Proteins (%)	0.65 (0.081)	0.31 (0.04)	0.57 (0.06)
Ash (%)	0.3 (0.052)	0.32 (0.09)	0.42 (0.05)
Fat (%)	-	-	0.31 (0.03)
Ascorbic acid (mg/100g)	32.43 (3.05)	38.21 (2.50)	-

*Figures are the means of triplicate values. Values in the parentheses are standard deviations.

This chemical composition data for the fresh *paneer* whey, lemon juice and orange juice was found slightly different than the data obtained by Rupnar (2006) and other literature, due to the variation of species, differences in maturity, area of cultivation of the orange and lemon used, etc.

Effect of orange juice variation on sensory quality

The semi-trained panelist expressed their evaluations of whey based beverage prepared from different variations in the context of various parameters of beverage namely, color, flavor, taste and overall acceptance. The panelists provided scores as per their perception of the sensory parameters in beverages as given in Fig.1.



Sensory parameters

Fig. 1 Effect of orange juice variation on sensory score of the beverages

*Similar alphabets at the top of the same sensory characteristics indicate no significant difference at $p \leq 0.05$.

Ascorbic acid content of control and the prepared beverages

Four different prepared samples (A, B, C and D) and control sample E had ascorbic acid content of 2.69± 0.56, 3.87 ± 0.61, 5.15± 0.50, 5.42± 0.80 and 0.35± 0.10

mg vitamin C per 100 ml of the beverages respectively as shown in Fig. 2.

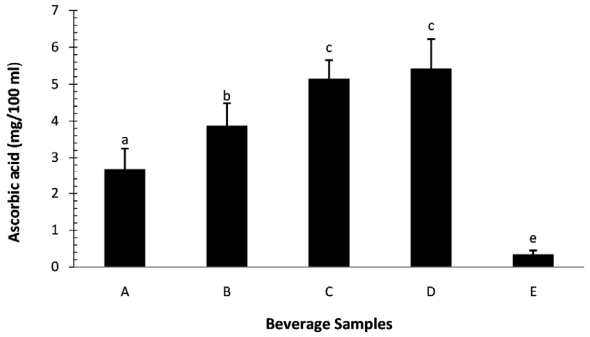


Fig. 2 Ascorbic acid content of the sample beverages A, B, C, D and control beverage E

*Similar alphabets at the top of the bar indicate no significant difference at $p \leq 0.05$.

(Note : A = 10% orange juice, B = 12.5% orange juice, C= 15% orange juice, D= 17.5% orange juice, E= 0% orange juice)

From LSD, significant difference were seen in the products A and B, A and C, A and D, A and E, B and C, B and D, B and E, C and E, D and E, while the products C and D were not significantly different at $p \leq 0.05$. In terms of sensory parameters- color, taste, flavor and overall acceptability, the sample C received higher scores (Fig. 1) than the rest formulations. Hence, from sensory evaluation and vitamin C content analysis, sample C was considered to be superior formulation.

Chemical composition of the final product and control sample

The chemical composition of control beverage and final beverage is presented in Table 2.

Table 2. Chemical composition of final product (dry basis)

S.N.	Parameter	Control beverage	Optimized beverage
1.	T.S.S (ºBx)	11.67 (0.025)	12 (0.1)
2.	Moisture (%)	92.221 (0.954)	90.04 (0.03)
3.	pH	4.80 (0.045)	4.35 (0.057)
4.	Acidity (%)	0.33 (0.02)	0.40 (0.01)
5.	Reducing sugar (%)	4.94 (0.07)	5.04 (0.07)
6.	Total sugar (%)	10.24 (0.32)	11.65 (0.24)
7.	Proteins (%)	0.627 (0.09)	0.53 (0.12)
8.	Total Ash (%)	0.66 (0.06)	0.57 (0.05)
9.	Fat (%)	0.23 (0.04)	0.18 (0.02)
10.	Ascorbic acid (mg/100 ml)	0.35 (0.68)	4.58 (0.51)

*Values are the means of triplicates values and values in the parentheses are the standard deviations

Conclusions

Based on this research work, *Paneer* whey beverage of acceptable quality could be prepared successfully using *paneer* whey, orange juice, lemon juice and sugar as the main ingredients. The best formulation of *paneer* whey beverage was the product containing 15% orange juice (v/v), 8% sugar (w/v) and 1% lemon juice (v/v) and 76% (v/v) *paneer* whey, having TSS of 12 ± 0.1 °Bx, 0.40 ± 0.01% acidity, pH of 4.35 ± 0.05, 5.04 ± 0.07% reducing sugar, 11.65 ± 0.24% total sugar, 0.53 ± 0.12% protein, 0.18 ± 0.02% fat, 0.57 ± 0.05% Total ash, and 4.58 ± 0.51 mg per 100 ml vitamin C.

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