**CHEMICAL QUALITY OF WHEY BEVERAGE USING KINNOW JUICE**

**ABSTRACT**

In the laboratory of the Department of Animal Husbandry and Dairying (Dairy Technology), C.S.A. University of Agriculture and Technology, Kanpur, the current study, "Technology of Preparation of Whey Beverage Using Kinnow Juice," was carried out. In the experiment, four levels of sugar (8.0, 10%, 12%, and 14%) and five levels of Kinnow juice (20, 25%, 30%, 35%, and 40%) were used to prepare a whey beverage utilizing Kinnow juice. The four physical characteristics—flavor, color and appearance, sweetness, and overall acceptability—as well as the chemical quality—fat, moisture, protein, carbohydrate, and ash percent—were evaluated after three replications. The study discovered that utilizing 12% sugar and 25% Kinnow juice can produce a higher-quality whey beverage. However, other combinations of this experiment were also shown to be good based on physical and chemical criteria. Therefore, it is advised that whey with 12% sugar and 25% Kinnow juice be used to create the most popular whey-based beverage.

**Keywords:** Whey beverage, Kinnow juice, Flavour, Sugar, Technology.

**INTRODUCTION:**

A by-product of the production of cheese, quarg, casein, chhana, paneer, and other goods is whey. An estimated 160 million kg of whey are produced as a by-product each year in India, which might result in a significant loss of roughly 70,000 tons of nutrient-dense whey solids. There are two varieties of whey based on its acidity. First, whey with a pH between 5 and 7 is called sweet whey, and it is typically obtained as a by-product in the production of cheese, Chhana, and Chakka. Another form of whey that is obtained from the manufacturing of casein is called acid whey, and it has a pH between 4 and 5. The most valuable part of whey protein, which is better than proteins from other sources and most efficient at supplying the body's energy and amino acid needs. While ß-Lactoglobulin is employed in sports and dietetic beverages, the individual components of whey proteins, such as lacto-albumin, are used in humanized infant food formulas. The branched-chain amino acids valine, isoleucine, and leucine are present in trace levels in whey proteins. These three amino acids make up around one-third of our muscle tissue. In addition, leucine and other branched-chain amino acids seem to slow down the breakdown of muscle tissue and encourage the growth of new muscle fibers. Leucine may help burn fat in addition to helping you preserve lean muscle mass, which would improve your body composition overall. Whey protein is better than proteins from other sources and is the most efficient at supplying the body with the amino acids and energy it needs.

**KINNOW:** The Rutaceae family includes the citrus group (Citrus nobilis lour× citrus deliciosa tenora). It includes grapefruit, lemon, lime, sweet orange, and mandarin. The citrus hybrid known as Kinnow (Citrus nobilis lour × Citrus deliciosa tenora) is a member of the Mandarin group. Dr. H. B. Frost created Kinnow, a hybrid between King and Willow leaf mandarin, in 1935 in California. J.C. Bakhshi brought this cultivar to India in 1958 at the Punjab Agricultural University's Regional Fruit Research Station in Abohar. Because of its superior fruit quality, increased cropping potential, and superior performance compared to other citrus fruits, kinnow has grown incredibly popular among growers and consumers. The production of soft beverages has advanced significantly over the past few years, although India currently offers a very small selection of varieties. Around the world, a wide variety of syrups, sherbets, and soft drinks with fake fruit flavors are widely recognized. Fruit drinks made from whey still have a chance to succeed on the market today. These drinks are high in nutrients and have a higher energy content. These could be especially helpful in areas where there is a food shortage and poor nutrition that results in nutrient deficiencies.

**MATERIALS AND METHODS**

"Technology of Preparation of Whey Beverage using Kinnow Juice" was the current study conducted at the Dairy Technology Laboratory of the Chandra Shekhar Azad University of Agricultural and Technology in Kanpur. The final product was assessed for its sensory and chemical qualities, and the whey beverage manufacturing process was standardized based on several criteria under investigation. The supplies needed for the experiment, the techniques for processing milk to make beverages, and additional experiments are covered in this chapter.

**Flow diagram of manufacture of whey beverage using kinnow juice:**

Receiving Paneer/Chhana whey

↓

Preheating (35-40℃)

↓

Mixing of Sugar (600C)

↓

Heating (95-100℃)

↓

Cooling (Room Temp.)

↓

Adding of kinnow juice

↓

Bottling & sealing (Room Temp.)

↓

Cooling & storage (50C)

**Manufacturing Technology:**

Clear filtered buffalo milk whey was utilized to make the Kinnow juice whey drink, in accordance with Ray and De's suggested methodology. In a double-jacketed stainless steel vat, whey was preheated between 35 and 400C while being continuously stirred with a stainless steel ladle. After heating the whey to 600 degrees Celsius, sugar was progressively added while being constantly stirred. and heated between 95°C and 100°C. The whey is then allowed to cool to 50 C, and as soon as kinnow juice is added, it is briskly mixed. The product was put into sterile, clean, 200 ml glass bottles, which were then sealed with crown corks. The bottles were then progressively cooled to 5 °C in the freezer and kept there at that temperature.

**RESULTS AND DISCUSSION:**

The finding of the present investigation entitled “Technology of Preparation of whey beverage using kinnow juice” was carried out in the department of animal husbandry and dairying C S Azad university of Agriculture and technology Kanpur. First categories deals with sensory evaluation and the second with chemical qualities with regard to various kinnow juice levels ( 20%, 25%, 30%, 35%, 40% ) and sugar levels ( 8%, 10%, 12%, 14% ). The effect of kinnow juice (B) and sugar (S) on kinnow juice based whey beverage was observed on sensory evaluation (flavour, color & appearance, sweetness and over all acceptability) and chemical quality (fat, moisture, protein, total carbohydrate and ash per cent).The data thus obtained were analyzed in factorial completely randomized design. The result drawn and their interpretations for different characters have been presented and discussed systematically.

**CHEMICAL QUALITY OF WHEY BEVERAGE USING KINNOW JUICE**

1. **FAT:**

The fat per cent in the sample of kinnow juice based whey beverage observed in the laboratory. The detailed results are given in table 1(a), its analysis of variance in Table 1.(b) which revealed the following fact.

**Table-1(a): Effect of various kinnow juice and sugar levels on fat per cent of kinnow juice based whey beverage.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **TREATMENTS** | **S1** | **S2** | | **S3** | | **S4** | **Mean A** | |
| **B1** | 0.364 | 0.369 | | 0.383 | | 0.374 | 0.372 | |
| **B2** | 0.392 | 0.397 | | 0.411 | | 0.402 | 0.401 | |
| **B3** | 0.383 | 0.388 | | 0.402 | | 0.392 | 0.391 | |
| **B4** | 0.374 | 0.378 | | 0.392 | | 0.383 | 0.382 | |
| **B5** | 0.369 | 0.374 | | 0.388 | | 0.378 | 0.377 | |
| **Mean B** | 0.376 | 0.381 | | 0.395 | | 0.386 |  | |
| **Factors** | | | **C.D.** | | **SE(d)** | | | **SE(m)** | |
| **Factor(A)** | | | 0.006 | | 0.003 | | | 0.002 | |
| **Factor(B)** | | | 0.005 | | 0.002 | | | 0.002 | |
| **Factor(A** × **B)** | | | N.S. | | 0.005 | | | 0.004 | |

From Table 1(a), the means of different levels of all the factors for fat score of kinnow juice based whey beverage, the following fact was observed. The fat score of kinnow juice based whey beverage maximum mean score (0.401) was noted in sample B2 while minimum score (0.372) in B1 sample. From interactions of B×S, the maximum score (0.411) was noted in B2×S3 followed by B2×S4 and minimum (0.364) in B1×S1 sample.

**Table 1. (b):Analysis of variance of data obtained from fat percentage.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source of Variation** | **D.F.** | **Sum of Squares** | **Mean Squares** | **F-Calculated** |
| **Factor A** | 4 | 0.006 | 0.002 | 33.688 |
| **Factor B** | 3 | 0.003 | 0.001 | 21.360 |
| **Interaction A** × **B** | 12 | 0.000 | 0.000 | 0.018 |
| **Error** | 40 | 0.002 | 0.000 |  |
| **Total** | 59 | 0.011 |  | |

Analysis of variance of score fat Table-1 (b) the combination of kinnow juice levels (B) and sugar levels (S) indicate that the two factors kinnow juice (B) and sugar (S) differ significantly simultaneously and the interaction component of B×S was found non-significantly which indicates that both these factors influence fat score of kinnow juice based whey beverage.

Fig.1.: Effect of various kinnow juice and sugar levels on fat score of kinnow juice based whey beverage.

1. **MOISTURE:**

The effect of different treatment combinations on Moisture per cent of kinnow juice based whey beverage has been presented in the Table 2. (a) & 2. (b).

**Table.2(a): Effect of kinnow juice and sugar levels and on moisture content in kinnow based whey beverage.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **TREATMENTS** | **S1** | **S2** | | **S3** | **S4** | | **Mean A** | |
| **B1** | 88.318 | 88.161 | | 87.714 | 88.004 | | 88.049 | |
| **B2** | 87.423 | 87.266 | | 86.764 | 87.109 | | 87.141 | |
| **B3** | 88.172 | 87.557 | | 87.109 | 87.423 | | 87.565 | |
| **B4** | 88.004 | 87.870 | | 87.423 | 87.714 | | 87.753 | |
| **B5** | 88.161 | 88.004 | | 87.557 | 84.870 | | 87.898 | |
| **Mean B** | 88.016 | 87.772 | | 87.313 | 87.624 | |  | |
| **Factors** | | | | **C.D.** | | | **SE(d)** | | **SE(m)** | |
| **Factor(A)** | | | | 0.040 | | | 0.020 | | 0.014 | |
| **Factor(B)** | | | | 0.036 | | | 0.018 | | 0.013 | |
| **Factor (AxB)** | | | | **0.080** | | | **0.040** | | **0.028** | |

The maximum moisture per cent (88.318) was observed in the treatment combination B1×S1 and minimum score (86.764) in combination of B2×S3 Analysis of variance of sweetness score of Table-2 in whey beverage using kinnow juice, the factor of sugar 25% level all other combination of sugar and juice have been found non-significant.

**Table-2(b): Analysis of Variance Table:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source of Variation** | **D.F.** | **Sum of Squares** | **Mean Squares** | **F-Calculated** |
| **Factor A** | 4 | 5.781 | 1.445 | 616.667 |
| **Factor B** | 3 | 3.750 | 1.250 | 533.333 |
| **Interaction A** × **B** | 12 | 0.562 | 0.047 | 20.000 |
| **Error** | 40 | 0.094 | 0.0023 |  |
| **Total** | 59 | 10.188 |  | |

Fig.2.: Effect of various kinnow juice and sugar levels on moisture score of kinnow juice based whey beverage.

1. **PROTEIN:**

The proteins per cent in the samples of kinnow juice based whey beverage at various combination levels were observed in the laboratory. The detailed results are given in Table 3.(a) & 3.(b).

**Table-3.(a): Effect of various kinnow juice and sugar levels on Protein per cent of kinnow juice based whey beverage.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **TREATMENTS** | **S1** | **S2** | **S3** | **S4** | **Mean A** |
| **B1** | 0.442 | 0.448 | 0.465 | 0.454 | 0.452 |
| **B2** | 0.476 | 0.482 | 0.501 | 0.488 | 0.487 |
| **B3** | 0.465 | 0.471 | 0.488 | 0.476 | 0.475 |
| **B4** | 0.454 | 0.459 | 0.476 | 0.465 | 0.463 |
| **B5** | 0.448 | 0.454 | 0.471 | 0.459 | 0.458 |
| **Mean B** | 0.457 | 0.463 | 0.480 | 0.468 |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Factors** | **C.D.** | **SE(d)** | **SE(m)** |
| **Factor(A)** | 0.007 | 0.004 | 0.003 |
| **Factor(B)** | 0.007 | 0.003 | 0.002 |
| **Factor(A** × **B)** | N.S. | 0.007 | 0.005 |

From Table 3.(a), the means of different levels of all the factors for protein score of kinnow juice based whey beverage, the following fact was observed. The protein score of kinnow juice based whey beverage maximum mean score (0.487) was noted in sample B2 while minimum score (0.452) in B1 sample.

From interactions of B×S, the maximum score (0.501) was noted in B2×S3 followed by B2×S4 and minimum (0.442) in B1×S1 sample.

**Table 3.(b): Analysis of variance of data obtained from protein percentage.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source of Variation** | **D.F** | **Sum of Square** | **Mean Squares** | **F-Calculated** |
| **Factor A** | 4 | 0.009 | 0.002 | 28.708 |
| **Factor B** | 3 | 0.004 | 0.001 | 18.381 |
| **Interaction A** × **B** | 12 | 0.000 | 0.000 | 0.009 |
| **Error** | 40 | 0.003 | 0.000 |  |
| **Total** | 59 | 0.017 |  | |

Analysis of variance of score protein Table-3.(b) the combination of kinnow juice levels (B) and sugar levels (S) indicate that the two factors kinnow juice (B) has been found non-significant however sugar (S) significantly and the interaction component of B×S was found non-significantly which indicates that both these factors influences protein score of kinnow juice based whey beverage.

Fig.3.: Effect of various kinnow juice and sugar levels on protein score of kinnow juice based whey beverage.

1. **CARBOHYDRATE:**

The carbohydrate per cent in the samples of kinnow juice based whey beverage at various combination levels were observed in the laboratory. The detailed results are given in Table 4.(a).

**Table-4.(a): Effect of various kinnow juice and sugar levels on carbohydrate content per cent of kinnow juice based whey beverage.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **TREATMENTS** | **S1** | **S2** | **S3** | **S4** | **Mean A** |
| **B1** | 10.440 | 10.580 | 10.980 | 10.720 | 10.680 |
| **B2** | 11.240 | 11.380 | 11.830 | 11.520 | 11.493 |
| **B3** | 10.980 | 11.120 | 11.520 | 11.240 | 11.215 |
| **B4** | 10.720 | 10.840 | 11.240 | 10.980 | 10.945 |
| **B5** | 10.580 | 10.720 | 11.120 | 10.840 | 10.815 |
| **Mean B** | 10.792 | 10.928 | 11.338 | 11.060 |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Factors** | **C.D.** | **SE(d)** | **SE(m)** |
| **Factor(A)** | 0.107 | 0.053 | 0.037 |
| **Factor(B)** | 0.096 | 0.047 | 0.033 |
| **Factor(A** × **B)** | N.S. | 0.106 | 0.075 |

From Table 4.(a), the means of different levels of all the factors for carbohydrate content score of kinnow juice based whey beverage, the following fact was observed. The carbohydrate score of kinnow juice based whey beverage maximum mean score (11.493) was noted in sample B2 while minimum score (10.680) in B1 sample. From interactions of B×S, the maximum score (11.830) was noted in B2×S₃ followed by B2×S4 and minimum (10.440) in B1×S1 sample.

**Table 4.(b):Analysis of variance of data obtained from total carbohydrates percentage.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source of Variation** | **D.F.** | **Sum of Squares** | **Mean Squares** | **F-Calculated** |
| **Factor A** | 4 | 5.092 | 1.273 | 75.895 |
| **Factor B** | 3 | 2.444 | 0.815 | 48.578 |
| **Interaction A** × **B** | 12 | 0.003 | 0.000 | 0.017 |
| **Error** | 40 | 0.671 | 0.017 |  |
| **Total** | 59 | 8.210 |  | |

Analysis of variance of score total carbohydrates Table- 4.(b) the combination of kinnow juice levels (B) and sugar levels (S) indicate that the two factors kinnow juice (B) & sugars (S) has been found significantly and the interaction component of B×S was found non significant which indicates that both these factors influences lactose score of kinnow juice based whey beverage.

Fig.4.: Effect of various kinnow juice and sugar levels on total carbohydrates score of kinnow juice based whey beverage.

1. **ASH:**

The ash per cent in the samples of kinnow juice based whey beverage at various combination levels were observed in the laboratory. The detailed results are given in Table 5.(a).

**Table-5.(a): Effect of various kinnow juice and sugar levels on Ash per cent of kinnow juice based whey beverage.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **TREATMENTS** | **S1** | **S2** | **S3** | **S4** | **Mean A** |
| **B1** | 0.436 | 0.442 | 0.458 | 0.448 | 0.446 |
| **B2** | 0.469 | 0.475 | 0.494 | 0.481 | 0.480 |
| **B3** | 0.458 | 0.464 | 0.481 | 0.469 | 0.468 |
| **B4** | 0.448 | 0.453 | 0.469 | 0.458 | 0.457 |
| **B5** | 0.442 | 0.448 | 0.464 | 0.453 | 0.452 |
| **Mean B** | 0.451 | 0.456 | 0.473 | 0.462 |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Factors** | **C.D.** | **SE(d)** | **SE(m)** |
| **Factor(A)** | 0.009 | 0.004 | 0.003 |
| **Factor(B)** | 0.008 | 0.004 | 0.003 |
| **Factor(A** × **B)** | N.S. | 0.009 | 0.006 |

Table 5.(a), the means of different levels of all the factors for ash score of kinnow juice based whey beverage, the following fact was observed. The ash score of kinnow juice based whey beverage maximum mean score (0.480) was noted in sample B2 while minimum score (0.446) in B1 sample. From interactions of B×S, the maximum score (0.494) was noted in B2×S3 followed by B2×S4 and minimum (0.436) in B1×S1 sample.

**Table 5.(b):Analysis of variance of data obtained from ash percentage.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source of Variation** | | **D.F.** | | **Sum of Squares** | | **Mean Squares** | **F-Calculated** |
| **Factor A** | | 4 | | 0.009 | | 0.002 | 18.929 |
| **Factor B** | | 3 | | 0.004 | | 0.001 | 12.080 |
| **Interaction A** × **B** | | 12 | | 0.000 | | 0.000 | 0.012 |
| **Error** | | 40 | | 0.005 | | 0.000 |  |
| **Total** | 59 | | 0.018 | |  | | |

Analysis of variance of score ash Table-5.(b) the combination of kinnow juice levels (B) and sugar levels (S) indicate that the two factors kinnow juice (B) has been found non- significant and the interaction component of B×S was also found non-significant which indicates that both these factors influences lactose score of kinnow juice based whey beverage.

Fig.5.: Effect of various kinnow juice and sugar levels on ash score of kinnow juice based whey beverage.

**CONCLUSION**

On the basis of present investigation it was concluded that a very good quality kinnow juice based whey drink could be prepared by using 25 per cent kinnow juice and 12 per cent sugar. The data obtained on the basis of physico-chemical quality of whey drink prepared from Chhana/Paneer whey by using kinnow juice and different sugar levels as a result overall suitability of kinnow juice based whey drink was found better in case sample (B2×S3) prepared from whey with addition of 25 per cent kinnow juice and 12 per cent sugar.

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