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Comparative of Rose and Cocoa Flavored Whey-based Drink and its Physicochemical, Textural and Sensory Profile

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ABSTRACT: Ready-to-drink beverages provide convenience and portability for today's busy consumers. Whey proteins are often favored for these beverages due to their excellent nutritional value, neutral flavor, easy digestibility, and unique functional properties in beverage formulations. Whey, the liquid protein component of milk, makes up about 20% of milk's protein content and includes albumins, globulins, most of the lactose, and water-soluble nutrients. The disposal of whey, which remains after milk fat and casein are separated from whole milk, poses a significant challenge for the dairy industry, necessitating simple and cost-effective solutions. Utilizing whey to create valuable products could address this issue. A whey-based beverage was developed by blending rose essence and cocoa with whey, including a control of 150 ml of whey extract, and adding 2.5 g of cocoa powder along with 2 to 3 drops of rose extract. Each 150 ml beverage contained a fixed 10 g of sugar and was evaluated for various physicochemical and sensory characteristics to determine overall acceptability. The acidity and TSS (Total Soluble Solids) content was not affected. The study concluded that the beverage made by blending whey with rose milk essence was superior in most physicochemical, microbial, and sensory quality parameters.

Keywords: Whey, Physicochemical Analysis, Microbial Analysis, Sensory Evaluation, rose.

INTRODUCTION

The food processing industry, including dairy and cheese plants, produces substantial amounts of liquid waste, notably "cheese whey." Approximately 90% of the milk used in cheese production is converted into whey, making it the most significant byproduct. Globally, around 180 to 190 million tons of whey are produced annually. Whey contains approximately 55 g/100 g of milk's total components, including lactose, soluble proteins, lipids, and mineral salts, which has led to its reclassification as a valuable product rather than waste (Pires *et al.,* 2021).

Whey protein represents about 20% of milk's total protein, with casein making up the remaining 80%. During milk processing, caseins are responsible for curd formation, while whey stays in a soluble form. Due to its high protein content, whey can be used in creating various protein-rich beverages, especially when its astringency is removed. Whey-based beverages are not only nutritionally important but also serve as functional beverages and sports drinks due to their emulsifying properties (Park *et al.,* 2019). Whey protein is regarded as an excellent protein choice for people of all ages, supporting a healthy diet and overall well-being. Traditionally, it was primarily used by athletes and bodybuilders to enhance muscle growth. Research indicates that whey protein and its bioactive components offer greater benefits than other protein sources like egg and casein. The consumption of whey protein appears to have anti-obesity effects and helps preserve muscle mass during dieting by boosting thermogenesis and maintaining lean body mass (West *et al.,* 2017).

Rosa damascene Mill, a significant plant in the Rosaceae family, has a long history of use in Iranian traditional medicine. While traditionally utilized as rose water or dried rose petals, its primary applications include producing rose water and essential oils, used in religious ceremonies, cooking, and high-end perfumes (Sharma *et al.,* 2023). Cocoa, one of the richest sources of flavanols—accounting for about 60% of the total

phenolics in raw cocoa beans—plays a significant role in human dietary flavonoid intake. Cocoa flavanols, primarily composed of flavanol monomers (epicatechin and catechin) and procyanidin oligomers (from dimers to decamers), are recognized for their potent antioxidant properties (Del Carmen Razola-Díaz *et al.,* 2023).

When the whey drink was prepared with rose and cocoa, it will enhance the flavor of the drink, and enhance the whey drink consumption among the consumers. The main objective of this study was

1. To prepare the whey-based drink using rose and cocoa
2. To analyze the physicochemical properties, nutritional and microbial analysis
3. To compare the both flavored whey-based drink by sensory analysis

MATERIALS AND METHODS

Materials. The required materials such as milk, cocoa powder, rose extract was purchased from market in Varanasi.

Preparation of whey-based drink. The whey based flavoured drink was prepared by process given in Fig. 1.

Assessment of pH. The pH of the sample was measured using a digital pH meter (pH Tutor, Eutech Instruments Pvt. Ltd., Singapore). Before measurement, the pH meter was calibrated with commercial buffer solutions at pH 9.0 and 4.0. Approximately 10 ml of the sample was placed in a glass container, and the pH electrode was inserted and measured.

Assessment of acidity. The titratable acidity, expressed as lactic acid equivalent, was calculated using the AOAC (2012) procedures.

Assessment of colour. The color of the sample was measured using a Hunter Lab Color Flex meter (Hunter Associates Laboratory, Inc., Reston, Virginia, USA). This device provides readings in terms of L, a, and b values, where L (luminance) represents the vertical axis indicating the scale from whiteness to darkness. The chromatic portion is defined by the a value, where (+) indicates redness and (-) indicates greenness, and the b value, where (+) indicates yellowness and (-) indicates blueness.

Estimation of Total Soluble Solids (TSS). Total soluble solids were measured using a hand refractometer, which assesses the refractive index of the sample.

Proximate Analysis. The proximate analysis of the paneer samples was conducted using conventional methods outlined by AOAC. The fat, protein, and moisture content were expressed as percentages. Protein was estimated using the Kjeldahl method, while fat was quantified using the Soxhlet apparatus. The ash and carbohydrate content were determined following AOAC procedures.

Antioxidant activity. The antioxidant properties of the soft drink were evaluated by measuring its ability to neutralize free radicals. The DPPH radical was used for this test (Balakrishnan & Agrawal 2014).

Sensory Evaluation. The sensory properties of the paneer samples were evaluated by semi-trained judges from the Banaras Hindu University, Varanasi. Each panelist used a standard scorecard based on a 9-point hedonic scale to rate sensory attributes, including color and appearance, flavor, body and texture, and overall acceptability of the product.

Statistical analysis. To ensure reliability of the results, all experimental measurements were replicated three times. Additionally, the entire experiment was repeated independently on three separate occasions. Statistical analysis of the data was conducted using IBM SPSS Statistics software.

RESULTS AND DISCUSSION

Proximate analysis. Proximate analysis of control and flavoured whey beverage and their Analysis of variants are presented in Table 1. The moisture content of control and flavoured whey beverage was 92.9, 91.05 and 89.32 respectively. A high significant difference was found in the moisture content of control and flavoured whey beverage. The moisture content in the product is reduced by added compounds in the product as compared to the control. A similar result was obtained in whey mango-based beverage developed by Ahmad *et al*. (2018) and they reported a moisture content of plain whey is 94.2 and whey mango beverage is 82.6 percent.

The mean values of protein content of control and flavoured whey beverage was 0.76, 0.79 and 1.3 respectively. There is a high significant ($P \leq 0.01$) difference in protein content between control and the flavoured whey beverage. Addition of rose essence and cocoa powder might increased the protein content in the flavoured whey beverage, and this is comparable with the results of Rizk (2016) in the whey beverage added with mint leaves developed.

The mean values of fat content of control and product was 0.065, 0.067 and 0.07 respectively. The fat content in both control and flavoured whey beverage because the addition of both compounds will not increase the fat content. A minimum increase of fat percentage (0.05) percent was obtained in the cocoa powder beverage. Similar studies also reported same fat per cent using fat separated whey reported by Rajendrabhai and Prajapati (2017).

The mean value of fibre content in both control and rose essence flavored whey beverage was not detected but incorporation of cocoa powdered whey beverage indicated 0.05 per cent of fibre content. Similarly, Fathimath Naurin *et al.* (2023) reported increase in fibre content of whey-based beverage.

The mean of ash content of control and product was 0.42, 0.5 and 0.59 respectively. Highly significant difference ($P \leq 0.01$) in the ash content of control and product were observed. The results are similar with the findings of Rizk (2016).

Physico-chemical properties of whey drink. The statistical analysis presented in the Table 2 showed that there was a highly significance difference ($p \leq 0.01$) between the control (whey), S1 and S2. The mean ±SE pH value of control was 4.23, while the pH of S1 and S2 were observed as 5.7 and 5.6 respectively. The mean ±SE of TA value of control was 0.65, while the pH of

S1 and S2 were observed as 0.63 and 0.69 respectively. Similar results were obtained by Kumar *et al.* (2019) who stated that a constant increase in the acidity level in coffee beverage from (0.144 to 0.150).

The mean of total solids content of control and product was 4.55, 6.54 and 8.59 respectively which indicate that TSS content is more in product when compared to the control due to addition of extracts. The results are similar with the results of Singh *et al.* (2014). This was in accordance with the experiment by Kumar *et al.* (2019) who stated that an increase in total soluble solids content of coffee beverage with brown seaweed.

Colour profile of whey drink. The mean ± SE colour values of control and flavored beverage were represented in Table 2. The respective mean values of L* for control and samples (S1 and S2) were 59.72, 67.2 and 70.2 mean while the mean values of a* and b* for control and samples (S1 and S2) were 1.70, -0.10 and -0.30; 1.25, 1.48 and 0.38 respectively. The result was in agreement with the findings of Pindi *et al.* (2017) discovered that when seaweed was added to mechanically deboned chicken meat (MDCM) sausage samples, the color L*-value (lightness) increased when compared to the control sample, the redness a*-value (redness) decreased.

Antioxidant activity. The ability of formulated whey-based drinks to scavenge the free radicals formed was assessed using 1, 1 diphenyl 2, picrylhydrazyl assay (DPPH) and it was compared with standard ascorbic acid. The maximum percentage of DPPH radical scavenging activity of formulated soft drink was at (100 µg/ml) so sample A had 60.56±10.36 % inhibition at (100 µg/ml) and sample B had 51.64±6.14 % inhibition at (100 µg/ml) which was illustrated in Fig. 2 and 3. The rose extracted added whey drink have more antioxidant when compared to the cocoa flavored drink. The results can correlate with Sharma *et al.* (2023) who analyzed DPPH assay of rose and revealed that the Rose leaves are abundant in substances with antioxidant properties.

Sensory evaluation. The sensory scores of rose and whey flavored whey drink was illustrated in Fig. 4. The findings of this study suggest that soft drink for sensory attributes ranged from 8.9 to 7.5. The rose extract and cocoa gave palatable and sharp taste to the whey drink. The prepared drink was picturized in Fig. 5. It was also revealed that the flavored whey drink has a positive influence in the opinion of consumers.

Table 1: Proximate analysis (Mean±SD) of control and flavored whey beverage.

Parameters (Per cent)	Samples		
	Control	Rose	Cocoa Powder
Moisture	92.9±0.669	91.05±0.21	89.32±0.15
Fat	0.065±0.01	0.067±0.03	0.07±0.02
Fibre	0.00	0.00	0.05±0.01
Protein	0.76±0.010	0.79±0.01	1.3±0.62
Ash	0.42±0.096	0.50±0.05	0.59±0.01

Table 2: Physico-chemical properties (Mean±SD) of optimized whey beverages.

Parameters (Per cent)	Samples		
	Control	Rose (S1)	Cocoa Powder(S2)
pH	4.23±0.08	5.7±0.025	5.6±0.025
TA	0.65±0.008	0.63±0.05	0.69±0.05
TSS	4.55±0.068	6.54±0.18	8.59±0.02

Table 3: Colour properties (Mean±SE) of optimized whey beverages

Parameters (Per cent)	Samples		
	Control	Rose (S1)	Cocoa Powder(S2)
L*	59.72 ± 0.09	67.2±0.05	70.2±0.06
a*	1.70 ± 0.07	-0.10±0.00	-0.30±0.02
b*	1.25 ± 0.08	1.48±0.09	0.38±0.05

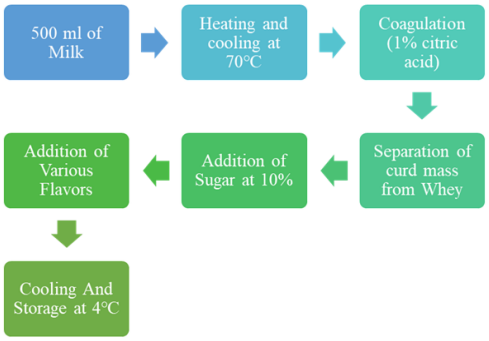

Fig. 1. Preparation of whey-based drink.

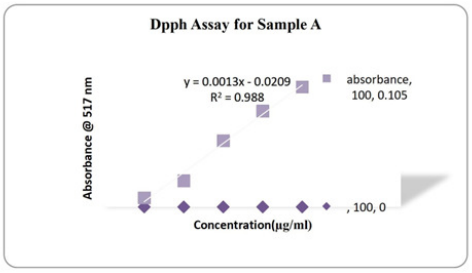

Fig. 2. DPPH activity of Rose flavored whey drink.

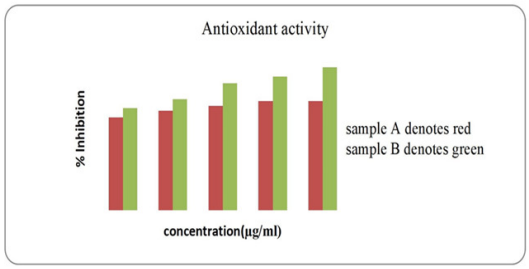

Fig. 3. Antioxidant activity of Rose flavored (sample A) and cocoa flavored (Sample B) whey drink.

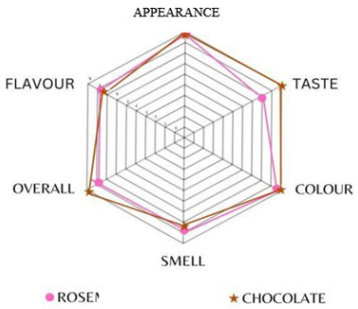

Fig. 4. Sensory scores of Flavored whey drink.

Fig. 5. Prepared rose and cocoa flavored whey drink.

CONCLUSIONS

The study successfully developed a whey-based beverage with desirable taste and nutritional value. The physical properties were not affected. The study concluded that the beverage made by blending whey with rose milk essence was superior in most physicochemical, microbial, and sensory quality parameters. The addition of cocoa improves the fibre and protein content of drink. The rose flavoured whey drink slightly improves the protein content and colour of the final product. The flavoured extracts have so much impact on antioxidant potential of the final product. The flavoured beverages were more advantageous in physicochemical nature which maintains the stable acidity value. This product shows promise for commercialization using the same production process. By transforming whey, a dairy byproduct, into a nutritious drink, the study offers a solution to dairy industry waste management. Future research can explore additional product variations and further processing of the remaining whey. The shelf life and sedimentation of the whey beverage was considerable limitation.

FUTURE SCOPE

The prepared flavored whey drink will be beneficial for byproduct valorization during manufacturing of coagulated dairy products in dairy industries. The flavoured whey drink will create opportunities for making revenue from whey.

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Conflict of Interest. None.

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