Development and Sensory Evaluation of Aloe vera and Coconut Water based Whey Beverages Prepared from Camel and Goat Milk

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10.18805/ajdfr.DR-1742

ABSTRACT

Background: Aloe vera juice, coconut water, honey and whey may be used to form a medicinal, prophylactic and nutritionally rich product, which might boost its demand in the food and beverage business.

Methods: The purpose of the research was to formulating the different types of whey beverages and estimate the sensory quality of whey beverages which prepared from camel and goat milk (70%, 30%). The formation of whey beverages blended in various combinations of whey, aloe vera juice (5%, 10% and 15%), coconut water (5%, 10% and 15%), honey (5%) and black salt (1%).

Result: On the basis of sensory evaluation such as appearance/colour, flavour, taste and overall acceptability the preparation of aloe vera based whey beverages with a composition of 79% whey and 15% aloe vera juice (T_1A_3) had obtained maximum overall acceptability (7.54 ± 0.050), whereas for coconut water-based whey beverage the composition of 79% whey and 15% coconut water (T_2C_3) had obtained maximum overall acceptability (7.29 ± 0.032). In comparison to control whey beverage, fortified whey aloe vera beverage and whey coconut water beverage was found to be more acceptable because it had a good flavour and taste, as well as overall acceptability.

Key words: Aloe vera juice, Coconut water, Sensory evaluation, Whey beverages.

INTRODUCTION

Whey is the watery liquid left after milk has been curdled and strained. It contains approximately half of the total milk solids and is a source of essential nutrients such as whey proteins, lactose, milk salts and most of the vitamins that are water soluble (Naik *et al.*, 2009). Whey has preventive and healing components and is particularly used to treat a wide range of disorders, such as arthritis, anaemia and liver complaints (Cruz *et al.*, 2009).

The camel (*Camelus dromedarius*) has significant socioeconomic importance in arid and semiarid regions (Rajasthan) of the world and its milk constitutes an important component of human diets in these regions (Rajasthan). More recently, studies have reported that camel milk is unique in terms of antioxidative factors, antibacterial, antiviral, antifungal, antihepatitis, paratuberculosis, hypoglycaemic function, anticancer, aging prevention and autoimmune disease remedy (Sharma and Singh, 2014).

Goat (*Capra hircus*) milk is used to treat various conditions including stomach disorders, vomiting, colic, diarrhoea, constipation and breathing problems (Getaneh *et al.*, 2016). Goat milk is vital for the prevention and immune stimulation of cardiovascular diseases, cancers, allergies and microorganisms. For children, an elderly and convalescent person, goat milk is recommended (Zenebe *et al.*, 2014).

The aloe vera (*Aloe barbadensis*) gel is an important for type-2 diabetes as an antihyperglycemic agent. It decreases the amount of blood glucose without disturbing the usual level of blood lipids and liver/kidney function (Huseini *et al.*, 2012). Whereas, it contains a variety of antioxidants, such as alpha-tocopherol, carotenoids,

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How to cite this article: Sharma, N.C., Bais, B., Vyas, J. and Sharma, A. (2022). Development and Sensory Evaluation of Aloe vera and Coconut Water based Whey Beverages Prepared from Camel and Goat Milk. Asian Journal of Dairy and Food Research. DOI: 10.18805/ajdfr.DR-1742.

Submitted: 02-06-2021 **Accepted:** 08-12-2021 **Online:** 22-02-2022

ascorbic acid, flavonoids, vitamin C and E, tannins (Radha and Laxmipriya, 2015).

Coconut (*Cocos nucifera*) water can help for regulating the level of blood sugar, prevent diabetes, improve cardiovascular health and lower the risk of serious cardiovascular disease by lowering the cholesterol/triglyceride levels. It can be beneficial for blood pressure control and helps to lower the risk of heart diseases and help in balancing the electrolytes of the body (Bhagya *et al.*, 2010).

Honey has many antioxidants that are protective against the development of cancer. It is anti-bacterial, anti-viral and anti-fungal and it is suitable for wound healing with all of

these properties. Asthmatic people will benefit from taking honey every day as well (Kumar *et al.*, 2010).

Looking at the health benefits of aloe vera juice, coconut water and whey, the aim of study was to produce whey beverages that are nutritious as well as palatable with different proportions of aloe vera juice and coconut were developed.

MATERIALS AND METHODS

Whey obtained during process of paneer preparation by using 70% of camel milk and 30% of goat milk was used to prepare control whey beverage (T_0) and treatment whey beverages. The following treatment combinations were formulated (Table 1 and 2):

T_0 (Control)- Whey beverage contains 94% plain whey, 5% honey and 1% black salt.

T_{1A_1} - Aloe vera based whey beverage contains 89% whey, 5% aloe vera juice, 5% honey and 1% black salt.

T_{1A_2} - Aloe vera based whey beverage contains 84% whey, 10% aloe vera juice, 5% honey and 1% black salt.

T_{1A_3} - Aloe vera based whey beverage contains 79% whey, 15% aloe vera juice, 5% honey and 1% black salt.

T_{2C_1} - Coconut water based whey beverage contains 89% whey, 5% coconut water, 5% honey and 1% black salt.

T_{2C_2} - Coconut water based whey beverage contains 84% whey, 10% coconut water, 5% honey and 1% black salt.

T_{2C_3} - Coconut water based whey beverage contains 79% whey, 15% coconut water, 5% honey and 1% black salt.

A jury of five judges evaluated prepared drinks using an 8-point hedonic scale to determine sensory characteristics such as appearance/color, flavour, taste and overall acceptability. The sensory assessment involved eight semi-trained panelists (Randomly selected members from college these are like Assistant Professors, Professors, Students and other persons). Under fluorescent light, the control whey beverage, as well as all of the aloe vera-based whey beverages and coconut water-based whey beverages, is delivered in clear plastic bottles. All samples were labeled and the order in which they were shown to each panelist was randomized and after properly examined panelists give their result of given parameter of 8-point hedonic scale.

Table 3: Sensory evaluation of prepared whey beverages.

Treatment	Appearance/color	Flavor	Taste	Overall acceptability
T_0	6.14 ^a ±0.032	6.23 ^b ±0.027	6.10 ^a ±0.052	6.61 ^a ±0.011
T_{1A_1}	6.63 ^c ±0.028	6.73 ^c ±0.048	6.53 ^c ±0.032	6.63 ^c ±0.028
T_{1A_2}	7.02 ^d ±0.017	7.13 ^d ±0.063	6.95 ^d ±0.038	7.03 ^d ±0.022
T_{1A_3}	7.56 ^e ±0.052	7.70 ^e ±0.049	7.38 ^e ±0.027	7.54 ^e ±0.050
T_{2C_1}	6.43 ^b ±0.027	6.12 ^a ±0.026	6.23 ^b ±0.023	6.26 ^b ±0.019
T_{2C_2}	6.74 ^d ±0.029	6.71 ^e ±0.031	6.63 ^c ±0.044	6.69 ^c ±0.034
T_{2C_3}	7.44 ^f ±0.038	7.32 ^e ±0.026	7.11 ^e ±0.043	7.29 ^e ±0.032

Means bearing different superscripts within column (small letter) differ significantly. ** = Highly Significant ($P < 0.01$). T_0 (Control or plain whey beverage), T_{1A_1} (Aloe vera based whey beverage 5%), T_{1A_2} (Aloe vera based whey beverage 10%), T_{1A_3} (Aloe vera based whey beverage 15%), T_{2C_1} (Coconut water-based whey beverage 5%), T_{2C_2} (Coconut water-based whey beverage 10%), T_{2C_3} (Coconut water-based whey beverage 15%).

RESULTS AND DISCUSSION

Sensory evaluation

On the basis of this above sensory assessment we prepared the final table of sensory evaluation of whey beverages which has been presented in Table 3 and depicted in Fig 1. The average point for appearance/color, taste and flavor for different whey beverages varies from 6.10 to 7.70. The average point for appearance/ color of control or plain whey beverage (T_0) was found to be 6.14±0.032 and for aloe vera based whey beverage i.e. for T_{1A_1} , T_{1A_2} and T_{1A_3} , it was found to be 6.63±0.028, 7.02±0.017 and 7.56±0.052, respectively and for coconut water based whey beverage i.e. T_{2C_1} , T_{2C_2} and T_{2C_3} the average point for appearance/ color were observed to be 6.43±0.027, 6.74±0.029 and 7.44±0.038, respectively.

It may be observed that T_{1A_3} scored maximum point (7.56±0.052) for appearance/color by the panelists whereas control or plain whey beverage obtained minimum point (6.14±0.032) for appearance/color. So, it may be concluded that the inclusion of aloe vera and coconut water improve appearance/color of treatment whey beverages as compared to control whey beverage.

Table 1: Formulation for preparation of 100 ml of aloe vera based whey beverages (ABWB).

Treatment	Whey (%)	Aloe vera juice (%)	Honey (%)	Black salt (%)
T_0 (Control)	94	0	5	1
T_{1A_1}	89	5	5	1
T_{1A_2}	84	10	5	1
T_{1A_3}	79	15	5	1

Table 2: Formulation for preparation of 100ml of coconut water based whey beverages (CBWB).

Treatment	Whey (%)	Coconut water (%)	Honey (%)	Black salt (%)
T_0 (Control)	94	0	5	1
T_{2C_1}	89	5	5	1
T_{2C_2}	84	10	5	1
T_{2C_3}	79	15	5	1

The average point for flavor of T_0 was observed to be 6.23 ± 0.027 , whereas for T_1A_1 , T_1A_2 and T_1A_3 were observed to be 6.73 ± 0.048 , 7.13 ± 0.063 and 7.70 ± 0.049 , respectively and for coconut water-based whey beverages i.e., T_2C_1 , T_2C_2 and T_2C_3 were observed 6.12 ± 0.026 , 6.71 ± 0.031 and 7.32 ± 0.026 , respectively. Thus, from the results obtained for flavor of different treatment beverages, it may be observed that T_1A_3 obtained maximum (7.70 ± 0.049) for flavor by the panelists whereas control or plain whey beverage scored minimum point (6.23 ± 0.027). Thus, it may be concluded that inclusion of aloe vera and coconut water improve flavor of treatment whey beverages as compared to control whey beverage.

The average point for taste of T_0 (control) or plain whey beverage without addition of aloe vera juice or coconut water was observed to be 6.10 ± 0.052 whereas for T_1A_1 , T_1A_2 and T_1A_3 were found 6.53 ± 0.032 , 6.95 ± 0.038 and 7.38 ± 0.027 , respectively and for T_2C_1 , T_2C_2 and T_2C_3 were observed 6.23 ± 0.023 , 6.63 ± 0.044 and 7.11 ± 0.043 , respectively. From the results obtained for taste of different treatment beverages it may be observed that T_1A_3 scored maximum point (7.38 ± 0.027) for taste by the panelists whereas control or plain whey beverage obtained minimum point (6.10 ± 0.052). Thus, it may be concluded that inclusion of aloe vera and coconut water improve taste of treatment whey beverages as compared to control whey beverage.

On the basis of data presented in Table 3 whey beverages with a composition of 79% whey and 15%

aloe vera juice (T_1A_3) had obtained maximum overall acceptability (7.54 ± 0.050) whereas for coconut water based whey beverage the composition of 79% whey and 15% coconut water (T_2C_3) had obtained maximum overall acceptability (7.29 ± 0.032).

All the parameters of sensory evaluation are highly significant from each other ($P \leq 0.01$) for the all treatments of whey beverages. The variation in the sensory scores awarded for various fruit juice blends whey beverages on Overall acceptability can be due to customers' personal preferences for certain colours, flavours and tastes. The results of present investigation related to appearance/ color, taste, flavor and overall acceptability are agreement with the results of (Gorachiya, 2018) who also reported that control or plain whey beverage obtained minimum score for appearance/color, taste, flavor and overall acceptability than the treatment whey beverages. Similar study of sensory analysis was also conducted by Bhavsager *et al.* (2010), Kumar (2015), Abdulalim *et al.* (2018), Rohit *et al.* (2020) and Sharma *et al.* (2020).

Antioxidant properties

The determination of the ABTS activity (% inhibition) was done to test the antioxidant properties of aloe vera based whey beverages and coconut water based whey beverage as compared to control whey beverage. The analysis of ABTS activity (% inhibition) of whey based beverage was done under refrigerated storage condition (0, 3, 6, 9 and 12

Fig 1: Sensory evaluation of whey beverages. T_0 - Control, T_1A_3 - Aloe vera based whey beverage, T_2C_3 - Coconut water based beverage.

Table 4: ABTS activity (% inhibition) (mean $\pm$ SE) of prepared whey beverages.

Day	T_0	T_1	T_2	Overall
Day 0	12.06 ^{aA} $\pm$ 0.017	31.56 ^{aC} $\pm$ 0.012	28.54 ^{aB} $\pm$ 0.024	24.06 ^a $\pm$ 3.030
Day 3	11.93 ^{dA} $\pm$ 0.017	28.35 ^{dC} $\pm$ 0.020	25.33 ^{dB} $\pm$ 0.014	21.88 ^d $\pm$ 2.522
Day 6	9.84 ^{cA} $\pm$ 0.024	24.26 ^{cC} $\pm$ 0.012	22.16 ^{cB} $\pm$ 0.015	18.76 ^c $\pm$ 2.249
Day 9	8.34 ^{bA} $\pm$ 0.024	22.46 ^{bC} $\pm$ 0.088	19.34 ^{bB} $\pm$ 0.014	16.72 ^b $\pm$ 2.141
Day 12	6.83 ^{aA} $\pm$ 0.017	19.54 ^{aC} $\pm$ 0.018	15.94 ^{aB} $\pm$ 0.014	14.11 ^a $\pm$ 1.890
Overall	9.80 ^A $\pm$ 3.030	25.23 ^C $\pm$ 2.522	22.26 ^B $\pm$ 2.249	

Means bearing different superscript in a column (capital letter) and in a row (small letter) differ significantly. **= Highly significant ($P < 0.01$). T_0 - Control whey beverage, T_1 - Aloe vera based whey beverage (ABWB) and T_2 - Coconut water based whey beverage (CBWB).

days). The data of ABTS activity (% inhibition) has been shown in Table 4 and depicted in Fig 2. The present investigation of ABTS activity are in accordance of significant decrease with respect to the storage period were reported by Baba *et al.* (2016), Sady *et al.* (2013), Tak, (2017), Singh, (2017), Gorachiya (2018), Prajapat (2019), Singh (2020), León-López *et al.* (2020).

Proximate analysis

The data of proximate analysis of whey beverages which included moisture, dry matter, crude protein, ether extract and total ash has been presented in Table 5 and depicted in Fig 3. Present investigations are variable with the findings of (Rohit *et al.*, 2019) reported the moisture content of kiwi fruit whey drinks was 90.31, 86.35, 84.49 and 83.14%, 0.47,

0.51, 0.56 and 0.58% protein, 0.38, 0.47, 0.52 and 0.57% ash for T_1 , T_2 , T_3 and T_4 treatment, respectively. Whereas the treatments T_0 (control), T_1 (5%), T_2 (10%) and T_3 (15%) of the pineapple flavoured chhana whey beverage containing protein 0.57, 0.66, 0.73 and 12.67%, ash 0.44, 0.60, 0.76 and 0.78 per cent and moisture 86.71, 86.20, 85.62 and 85.50 per cent, respectively, these findings were reported by Bhavsager *et al.* (2010).

Cost of whey beverages

The cost of production per liter of plain whey beverage (control or T_0) was worked out as Rs. 25 whereas aloe vera based whey beverage (T_1A_3) was worked out as Rs. 36.2 and coconut water based whey beverage (T_2C_3) was worked out as Rs. 54.2.

Fig 2: ABTS (% inhibition) of prepared whey beverages. T_0 - Control, T_1A_3 - Aloe vera based whey beverage, T_2C_3 - Coconut water based beverage.

Fig 3: Proximate analysis of prepared whey beverages. T_0 - Control, T_1A_3 - Aloe vera based whey beverage, T_2C_3 - Coconut water based beverage.

Table 5: Proximate analysis (mean ± SE) of prepared whey beverages.

Treatment	Moisture	Dry matter	Crude matter	Ether extract	Total ash
T_0	93.58 ^a ±0.052	5.63 ^a ±0.024	0.71 ^a ±0.017	0.15 ^a ±0.035	0.84 ^a ±0.031
T_1A_3	91.82 ^a ±0.014	7.25 ^b ±0.031	1.23 ^c ±0.024	0.22 ^b ±0.023	0.94 ^b ±0.017
T_2C_3	92.74 ^b ±0.029	6.11 ^a ±0.046	1.20 ^b ±0.028	0.27 ^c ±0.026	0.86 ^b ±0.025

Means bearing different superscripts within column (small letter) differ significantly. **= Highly significant ($P < 0.01$). T_0 - Control whey beverage, T_1A_3 - Aloe vera based whey beverage (ABWB), T_2C_3 - Coconut water-based whey beverage (CBWB).

CONCLUSION

The main contribution of this study was to provide new knowledge about whey and whey-based beverages with its health benefits and nutritious properties. Whey beverages prepared from camel and goat milk (70% and 30%) with addition of different levels of aloe vera juice and coconut water added with constant level of honey and black salt was found to be highly acceptable. In comparison to control whey beverage, fortified whey-aloe vera beverage and whey coconut water beverage was found to be more acceptable as it gave good flavour and taste and overall acceptability. It is therefore concluded, among all the beverages, T₁A₃ obtained maximum acceptability, antioxidant property {as per mean ABTS activity 25.23±2.522 (at 0 to 12 days)} and lower cost (Rs. 36.2) and best for production. Since the beverage was made from discarded whey water, it contributes to a lower cost and has thus proved to be commercially viable.

Conflict of interest: None.

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