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HR Tidake

Department of Animal
Husbandry and Dairy Science,
College of Agriculture, Latur,
Maharashtra, India

AT Shinde

Associate Professor, Department
of Animal Husbandry and Dairy
Science, College of Agriculture,
Latur, Maharashtra, India

BM Thombre

Associate Dean and Principal,
College of Agriculture, Latur,
Maharashtra, India

Corresponding Author:

HR Tidake

Department of Animal
Husbandry and Dairy Science,
College of Agriculture, Latur,
Maharashtra, India

Chemical composition of Paneer whey beverage blended with bottle gourd (*Lagenaria siceraria*) extract

HR Tidake, AT Shinde and BM Thombre

Abstract

The present research was undertaken to study the effect of addition of bottle gourd (*Lagenaria siceraria*) extract on chemical composition of paneer whey beverage. The paneer whey beverage was prepared using paneer whey plus bottle gourd extract in proportion 100:00 (T₁), 70:30 (T₂), 60:40 (T₃) and 50:50 (T₄). The chemical composition (fat, protein, moisture, total solids, ash, lactose, total sugar and SNF) of paneer whey beverage blended with bottle gourd extract was determined. The protein (0.42, 0.45, 0.47 and 0.49 percent), moisture (93.37, 93.47, 93.52 and 93.57 percent) content of paneer whey beverage blended with bottle gourd extract increased significantly due to replacement of paneer whey with bottle gourd extract. However fat (0.51, 0.48, 0.46 and 0.44 percent), total solids (6.64, 6.54, 6.49 and 6.43 percent), ash (0.53, 0.43, 0.37 and 0.32 percent), lactose (4.76, 4.66, 4.61 and 4.56 percent), total sugar (6.25, 6.15, 6.11 and 6.05 percent) and SNF (6.13, 6.06, 6.03 and 6.00 percent) towards higher level of addition of bottle gourd extract in paneer whey.

Keywords: Buffalo milk, bottle gourd extract, paneer whey, SNF

Introduction

India stands first in milk production across the world contributing 24 percent of global milk production. The milk production of India for the year 2021-2022 was 221.06 million tonnes (Anonymous, 2022) [1]. Whey is a valuable by-product of dairy industry obtained during manufacture of cheese, *chhana*, paneer and *shrikhand* was not being utilized to its full extent, on the other hand whey had interesting nutritional constituent such as fat, protein and its discard is increasingly frowned upon by environmentalists. It is a major output of cheese industry. It carries precious nutrients like lactose, whey protein, minerals, and vitamins. These nutrients have an indispensable value in human dietary requirement (Prendergast, 1985 [17] and Mathur *et al.*, 1988 [13]). The total world production of whey was 85 million tonnes in which India contributes approximately 2, 80, 000 tonnes of the total global production (Shukla *et al.*, 2004 [22], Raju *et al.*, 2005 [18] and Mishra, 2008 [15]). Whey disposal is a serious problem for dairy industry. In order to reduce pollution load, whey should be treated to obtain commercial products (Gupta and Nair, 2010) [6]. The bottle gourd contains moisture, protein, fat, carbohydrate, fibre, ash, and energy (94.5±0.06 gm, 1.2±0.06 gm, 0.2±0.02 gm, 3.75±0.03 gm, 0.7±0.01 gm, 0.5±0.01 gm, and 15±0.12 Cal on dry weight basis), respectively. The bottle gourd edible part has niacin, ascorbic acid, potassium, calcium, and phosphorus 0.3, 12, 87, 12, and 37 mg, respectively. Potassium is available in more percent after phosphorus and calcium (Hanif *et al.*, 2006) [8]. Bottle gourd has high percent of water thus don't let human body to dehydrate, rich source of calcium and vitamins (C and K), shows cooling effect on human body and even act as a good laxative. It Provide relief to patients affected by heart problems, urinary disorders and insomnia. It also suggested for its properties like anti-diabetic and aphrodisiac. Bottle gourd pulp is helpful in overcoming cough, night blindness, constipation and also acts as antidote against certain poisons. Its pulp is a suitable substitute for people suffering from lactose intolerance and useful in managing many diseases like cardiac disorders, hepatic diseases and ulcer. Its high potassium content manages blood pressure of hypertensive patients. Also helpful in losing weight quickly because it is low in fat and cholesterol and provides high dietary fiber (Gupta *et al.*, 2022) [7].

Materials and Methodology

Collection of Buffalo milk

Buffalo milk was procured from local market of Latur city of Natural Milk Pvt. Ltd., Latur with 6.0 percent fat and 9 percent SNF.

Collection of Bottle gourd

Fresh bottle gourd was purchased from local market of Latur city.

Ingredients: Sugar

Good quality, clean, crystalline, white cube sugar was purchased from local market of Latur city.

Chemicals

Analytical reagents (AR) such as citric acid, sulphuric acid, amyl alcohol and NaOH were used in the analysis of paneer whey beverage.

Packaging materials

Glass bottles were used for packaging and storage of prepared whey beverage.

Equipment and accessories

Stainless steel vessels of requisite capacity, standard weight balance, thermometer, gas stove, muslin cloth, glass rod, mixer (grinder), Whatman no.1 filter paper, knives etc. were used for preparation of whey beverage. Before using this material, it was properly cleaned and washed with detergent solution. All the precautionary measures were taken during the conduct of trials to avoid contamination.

Methodology

Procedure for preparation of paneer whey

The buffalo milk (6 percent fat and 9 percent SNF) was heated in stainless steel vessel to 86 °C for 15 minute and cooled to 76 °C. After the cooling milk was acidified by addition of 1 percent citric acid solution with continuous stirring still coagulation of milk protein followed by filtration through muslin cloth, solid mass was used as paneer and filtered liquid portion as paneer whey which collected in suitable container.

Procedure for preparation of bottle gourd extract

Fresh bottle gourd were procured from local market of Latur city. The bottle gourd was washed with clean water and peeled off and cut into flakes with separation of seed followed by grinding the flakes and filtration of bottle gourd pulp through muslin cloth and collect bottle gourd extract in glass beaker.

Procedure for preparation of paneer whey beverage blended with bottle gourd (*Lagenaria siceraria*) extract

The paneer whey beverage blended with bottle gourd extract was prepared as per the method of Kamate, (2015) [10] with slight modifications. The paneer whey with 9 percent sugar was heated to 45 °C then bottle gourd extract was blended as per the treatment combinations. Then this mixture was heated to 105 °C for 5 minutes, filtered through muslin cloth, filled in the glass bottle and sealed. The bottle pasteurization of finished product was carried at 63 °C for 30 minutes and stored at 4 °C.

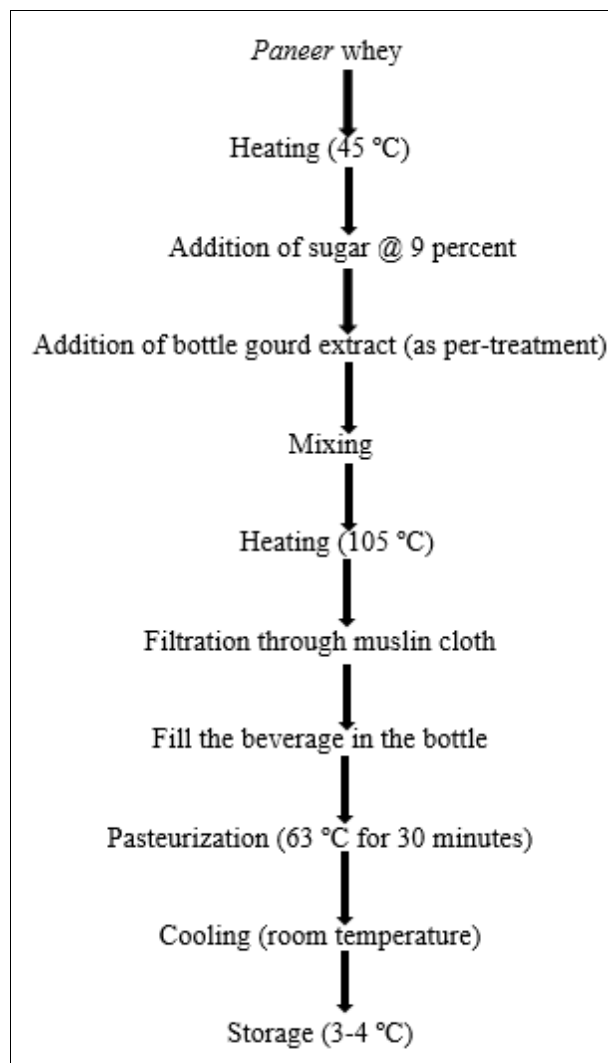


Fig 1: Flow chart for preparation of paneer whey beverage blended with bottle gourd (*Lagenaria siceraria*) extract (Kamate, 2015) [10]

Treatment Combination

For preparation of paneer whey beverage blended with bottle gourd (*Lagenaria siceraria*) extract with 9 percent sugar was added by weight of paneer whey and bottle gourd extract as per treatment combination were finalized on weight basis as follows:

T₁ - 100 parts of paneer whey

T₂ - 70 parts of paneer whey and 30 parts of bottle gourd extract

T₃ - 60 parts of paneer whey and 40 parts of bottle gourd extract

T₄ - 50 parts of paneer whey and 50 parts of bottle gourd extract

Evaluation of chemical composition of paneer whey beverage blended with bottle gourd extract

Paneer whey beverage samples of different treatments were subjected for analysis of protein {Lowry's *et. al.*, (1951)} [11], moisture/total solid/ash/SNF {IS: SP (Part XI) 1981} [9]. The data was analyzed statistically by using Completely Randomized Design (CRD) as per Panse and Sukhatme (1985) [16].

Results and Discussion

Fat content of paneer whey beverage blended with bottle gourd extract: The average fat content of control (T₁) and paneer whey beverage blended with bottle gourd extract 30, 40 and 50 percent (T₂, T₃ and T₄) was given in Table 1.

Table 1: Fat content of paneer whey beverage blended with bottle gourd extract (percent)

Replication	R ₁	R ₂	R ₃	R ₄	Mean
Treatment					
T ₁	0.51	0.52	0.50	0.49	0.51 ^a
T ₂	0.48	0.47	0.48	0.47	0.48 ^b
T ₃	0.45	0.46	0.46	0.45	0.46 ^c
T ₄	0.43	0.44	0.44	0.43	0.44 ^d
S. E.±0.0040, C. D. at 5% 0.013					

The values with different superscripts differ significantly at 5 percent level of significance.

The fat content of control (T₁) and whey beverage blended with bottle gourd extract T₂, T₃ and T₄ are 0.51, 0.48, 0.46 and 0.44 percent, respectively. Among the treatments fat content decrease significantly towards higher percent addition of bottle gourd extract in paneer whey. The decrease in fat of treated sample might be due bottle gourd extract with lower fat content (0.40 percent).

The results of present study are similar with Ghule *et al.* (2013) [5] who reported addition of bottle gourd pulp in *pedha* at 5, 10 and 15 percent found that decrease in fat from 16.15 to 14.12 percent.

The results of present study are in agreement with Wadatkar *et al.* (2020) [24] who reported that addition of orange juice in whey resulted in reduction in fat content from control (0.49 percent) to treated sample (0.23 percent). Similarly Meshram *et al.* (2019) [14] and Bhalekar *et al.* (2022) [3] reported fat content of *chhana* whey (0.48 percent) and paneer whey (0.31 percent) was decreased significantly after addition of strawberry juice in *chhana* whey to 0.46 percent and jackfruit pulp in paneer whey to 0.28 percent, respectively.

Protein content of paneer whey beverage blended with bottle gourd extract

The mean value of protein content for control (T₁) and paneer whey beverage blended with bottle gourd extract 30, 40 and 50 percent (T₂, T₃ and T₄) are presented in Table 2.

Table 2: Protein content of paneer whey beverage blended with bottle gourd extract (percent)

Replication	R ₁	R ₂	R ₃	R ₄	Mean
Treatment					
T ₁	0.41	0.43	0.42	0.41	0.42 ^d
T ₂	0.44	0.45	0.44	0.45	0.45 ^c
T ₃	0.46	0.47	0.46	0.47	0.47 ^b
T ₄	0.49	0.48	0.49	0.50	0.49 ^a
S. E.±0.0038, C. D. at 5% 0.012					

The values with different superscripts differ significantly at 5 percent level of significance.

The protein percentage for control (T₁) and whey beverage blended with bottle gourd extract T₂, T₃ and T₄ are 0.42, 0.45, 0.47 and 0.49 percent. The protein content of control sample was less than all treated sample and differ significantly from all treatment.

The protein percentage increase significantly towards higher

level of addition of bottle gourd extract in paneer whey. The significantly increase in protein content of treated sample was due to higher content of protein (1.0 percent) in bottle gourd extract.

The results of present study are in agreement with Wadatkar *et al.* (2020) [24] and Bhalekar *et al.* (2022) [3] who reported percent protein content of orange juice in paneer whey (0.49 percent) and jackfruit pulp addition in paneer whey beverage (0.73 percent) which was significantly higher as compared to control 0.42 and 0.47 percent, respectively.

Moisture content of paneer whey beverage blended with bottle gourd extract

The moisture content for control (T₁) and paneer whey beverage blended with bottle gourd extract 30, 40 and 50 percent (T₂, T₃ and T₄) are presented in Table 3.

Table 3: Moisture content of paneer whey beverage blended with bottle gourd extract (percent)

Replication	R ₁	R ₂	R ₃	R ₄	Mean
Treatment					
T ₁	93.36	93.39	93.37	93.34	93.37 ^d
T ₂	93.47	93.48	93.46	93.45	93.47 ^c
T ₃	93.52	93.53	93.49	93.52	93.52 ^b
T ₄	93.57	93.59	93.56	93.55	93.57 ^a
S. E.±0.00863, C. D. at 5% 0.027					

The values with different superscripts differ significantly at 5 percent level of significance.

The moisture content for control (T₁) and whey beverage blended with bottle gourd extract T₂, T₃ and T₄ are 93.37, 93.47, 93.52 and 93.57 percent. The moisture content of control sample was less than all treated sample and differ significantly from all treatment.

The moisture content increased significantly towards higher level of addition of bottle gourd extract in paneer whey. The significantly increase in moisture content of treated sample was due to higher moisture (95.30 percent) content in bottle gourd extract.

The result of present study similar with Bhutkar *et al.* (2015) [4] who reported addition of bottle gourd pulp in *basundi* at 5, 10 and 15 percent increased moisture content from 33.46 to 41.14 percent. Satpute *et al.* (2018) [20] who reported that addition of *mentha* extract in paneer whey with beetroot extract increased moisture content significantly (87.14 percent) than control (87.00 percent).

Total Solids content of paneer whey beverage blended with bottle gourd extract

The total solids content for control (T₁) and paneer whey beverage blended with bottle gourd extract 30, 40 and 50 percent (T₂, T₃ and T₄) are presented in Table 4.

Table 4: Total solids content of paneer whey beverage blended with bottle gourd extract (percent)

Replication	R ₁	R ₂	R ₃	R ₄	Mean
Treatment					
T ₁	6.64	6.61	6.63	6.66	6.64 ^a
T ₂	6.53	6.52	6.54	6.55	6.54 ^b
T ₃	6.48	6.47	6.51	6.49	6.49 ^c
T ₄	6.43	6.41	6.44	6.45	6.43 ^d
S. E.±0.0086, C. D. at 5% 0.027					

The values with different superscripts differ significantly at 5 percent level of significance.

The total solid content for control (T₁) and whey beverage blended with bottle gourd extract T₂, T₃ and T₄ are 6.64, 6.54, 6.49 and 6.43 percent, respectively. The total solids content of control sample was higher than all treated sample and differ significantly from all treatment.

The result indicated that the percent addition of bottle gourd extract 30 percent (T₂), 40 percent (T₃) and 50 percent (T₄) in paneer whey decreased total solids content significantly. This could be due to higher moisture (95.30 percent) and less total solids (4.70 percent) in bottle gourd extract.

The results of present study are in agreement with Ghule *et al.* (2013) [5] who reported addition of bottle gourd pulp in *pedha* at 5, 10 and 15 percent decreased in total solids from 81.68 to 76.95 percent. Satpute *et al.* (2018) [20] and Sunita, (2019) [23] who reported total solids content of paneer whey with beetroot extract (13.00 percent) and paneer whey with pineapple flavour (13.20 percent) which was decreased significantly after addition of *mentha* extract in paneer whey to 12.86 percent and ash gourd juice in whey to 11.67 percent, respectively.

Ash content of paneer whey beverage blended with bottle gourd extract

The ash content of control (T₁) and paneer whey beverage blended with bottle gourd extract 30, 40 and 50 percent (T₂, T₃ and T₄) was presented in Table 5.

Table 5: Ash content of paneer whey beverage blended with bottle gourd extract (percent)

Replication	R ₁	R ₂	R ₃	R ₄	Mean
Treatment					
T ₁	0.52	0.51	0.54	0.53	0.53 ^a
T ₂	0.47	0.42	0.41	0.43	0.43 ^b
T ₃	0.38	0.37	0.36	0.38	0.37 ^c
T ₄	0.33	0.32	0.31	0.34	0.32 ^d
S. E.±0.0083, C. D. at 5% 0.026					

The values with different superscripts differ significantly at 5 percent level of significance.

The percent ash content of paneer whey beverage blended with bottle gourd extract T₂, T₃ and T₄ was 0.43, 0.37 and 0.32 percent, respectively, which significantly lower than control (T₁) 0.53. Among the treatments ash content of T₂ (0.43) was highest and differ significantly from all treatments.

The result indicated that addition of bottle gourd extract in paneer whey decreased ash content significantly. This was due to less fat (0.40 percent) and lactose (0.5 percent) content in bottle gourd extract.

The results of present study are in agreement with Ghule *et al.* (2013) [5] who reported addition of bottle gourd pulp in *pedha* at 5, 10 and 15 percent found that decrease in ash from 2.40 to 2.16 percent. Mane and Pawar, (2019) [12] who reported that addition of pineapple juice in whey base tomato beverage, decreased ash content significantly from control (0.42 percent) to treated sample (0.33 percent) and mango juice addition in whey base tomato beverage decreased ash (0.38 percent) than control (0.51 percent). Similarly Sunita, (2019) [23] observed addition ash gourd juice in paneer whey decreased ash content (0.56 percent) significantly from control (0.62 percent).

Lactose content of paneer whey beverage blended with bottle gourd extract

The average value of lactose content for control (T₁) and paneer whey beverage blended with bottle gourd extract 30,

40 and 50 percent (T₂, T₃ and T₄) are presented in Table 6.

Table 6: Lactose content of paneer whey beverage blended with bottle gourd extract (percent)

Replication	R ₁	R ₂	R ₃	R ₄	Mean
Treatment					
T ₁	4.76	4.75	4.77	4.76	4.76 ^a
T ₂	4.65	4.66	4.67	4.66	4.66 ^b
T ₃	4.60	4.61	4.60	4.61	4.61 ^c
T ₄	4.55	4.56	4.56	4.55	4.56 ^d
S. E.±0.003, C. D. at 5% 0.011					

The values with different superscripts differ significantly at 5 percent level of significance.

The mean value of lactose for control (T₁) and whey beverage blended with bottle gourd extract T₂, T₃ and T₄ are 4.76, 4.66, 4.61 and 4.56 percent, respectively. The lactose of control sample was significantly higher than all treated sample and differ significantly.

The lactose content decreased significantly towards higher level of addition of bottle gourd extract in paneer whey. The decrease in lactose content of treated sample was due to addition of bottle gourd extract with lactose (0.5 percent).

The results of present study are in agreement with Anurag and Chawla, (2016) [2] observed that addition of bottle gourd shreds in *burfi* decreased reducing sugar (21.93 percent) than control (26.89 percent). Similarly Revathi and Singh (2014) [19] and Sharma *et al.* (2020) [21] who reported that addition of pineapple flavour in whey (3.75 percent) and ginger powder in *chhana* whey beverage (4.60 percent) decreased in lactose percentage significantly as compared to control 4.02 and 4.90 percent, respectively.

Total sugar content of paneer whey beverage blended with bottle gourd extract

The average value of total sugar content for control (T₁) and paneer whey beverage blended with bottle gourd extract 30, 40 and 50 percent (T₂, T₃ and T₄) are presented in Table 7.

Table 7: Total sugar content of paneer whey beverage blended with bottle gourd extract (percent)

Replication	R ₁	R ₂	R ₃	R ₄	Mean
Treatment					
T ₁	6.24	6.26	6.25	6.25	6.25 ^a
T ₂	6.14	6.16	6.14	6.14	6.15 ^b
T ₃	6.11	6.10	6.12	6.10	6.11 ^c
T ₄	6.05	6.06	6.05	6.04	6.05 ^d
S. E.±0.004, C. D. at 5% 0.014					

The values with different superscripts differ significantly at 5 percent level of significance.

The mean value of total sugar for control (T₁) and whey beverage blended with bottle gourd extract T₂, T₃ and T₄ are 6.25, 6.15, 6.11 and 6.05 percent, respectively. The total sugar of control sample was significantly higher than all treated sample and differ significantly.

The total sugar content decreased significantly towards higher level of addition of bottle gourd extract in paneer whey. The decrease in total sugar content of treated sample might be due to lower content of lactose (0.5 percent) in whey beverage blended with bottle gourd extract.

The results of present study are contradictory with Sharma *et al.* (2020) [21] who reported that addition of ginger powder in *chhana* whey beverage (15.77 percent) increased in total sugar as compare to control (14.91 percent) as due to sugar content in ginger powder.

SNF content of paneer whey beverage blended with bottle gourd extract: The average SNF content for control (T₁) and paneer whey beverage blended with bottle gourd extract 30, 40 and 50 percent (T₂, T₃ and T₄) are presented in Table 8.

Table 8: SNF content of paneer whey beverage blended with bottle gourd extract (percent)

Replication Treatment	R ₁	R ₂	R ₃	R ₄	Mean
T ₁	6.13	6.09	6.13	6.17	6.13 ^a
T ₂	6.05	6.05	6.06	6.08	6.06 ^b
T ₃	6.01	6.01	6.05	6.04	6.03 ^{bc}
T ₄	6.00	5.97	6.00	6.02	6.00 ^c

S. E. ±0.012, C. D. at 5% 0.035

The values with different superscripts differ significantly at 5 percent level of significance.

The SNF content for control (T₁) and whey beverage blended

with bottle gourd extract T₂, T₃ and T₄ are 6.13, 6.06, 6.03 and 6.00 percent. The SNF content of control T₁ (6.13) was highest and differ significantly from T₂, T₃ and T₄ (6.06, 6.03 and 6.00 percent). Among the treatments SNF content decreased gradually towards higher level of addition of bottle gourd extract. However, SNF content of T₂ and T₃ as well as T₃ and T₄ does not differ significantly.

The SNF content decrease significantly towards higher level of addition of bottle gourd extract in paneer whey. The decrease in SNF content of treated sample might be due to less content of SNF (4.3) in bottle gourd extract.

The results of present study are contradictory with Meshram *et al.* (2019) [14] who reported that addition of strawberry juice in *chhana* whey beverage (6.09 percent) increased in SNF as compare to control (5.92 percent) which was due to more total solid in strawberry juice.



Fig 1: Chemical composition of paneer whey beverage blended with bottle gourd extract

Table 9: Chemical composition of paneer whey beverage blended with bottle gourd extract

Treatment	Fat	Protein	Moisture	Total solids	Ash	Lactose	Total Sugar	SNF
T ₁	0.51 ^a	0.42 ^d	93.37 ^d	6.64 ^a	0.53 ^a	4.76 ^a	6.25 ^a	6.13 ^a
T ₂	0.48 ^b	0.45 ^c	93.47 ^c	6.54 ^b	0.43 ^b	4.66 ^b	6.15 ^b	6.06 ^b
T ₃	0.46 ^c	0.47 ^b	93.52 ^b	6.49 ^c	0.37 ^c	4.61 ^c	6.11 ^c	6.03 ^c
T ₄	0.44 ^d	0.49 ^a	93.57 ^a	6.43 ^d	0.32 ^d	4.56 ^d	6.05 ^d	6.00 ^d
S.E. ±	0.0040	0.0038	0.00863	0.0086	0.0083	0.003	0.004	0.012
C. D. 5%	0.013	0.012	0.027	0.027	0.026	0.011	0.014	0.035

The values with different superscripts differ significantly at 5 percent level of significance

Conclusions

From the present study it was concluded that paneer whey beverage blended with bottle gourd extract at 30, 40 and 50 percent level affected on chemical composition positively. The addition of bottle gourd extract at 30, 40 and 50 percent showed positive effect on proximate composition with respect to significant increase in protein, moisture and decrease in fat, total solids, ash, lactose, total sugar and SNF content of product.

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