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Effect of Hydrocolloids on Physico-Chemical and Sensory Quality of Whey Beverages

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Abstract*:The study was conducted to observe the influence of hydrocolloids on whey beverages. Initially the effect of two hydrocolloids (i.e. Carboxy-methylcellulose; CMC and high methoxyl pectin; HMP each with 0.1, 0.2, 0.4 and 0.6% concentrations) on acceptability profile of cow or buffalo milk whey beverages were evaluated and among these, the whey beverage (both cow or buffalo milk) with 0.2% CMC or HMP were found more acceptable. Further the influence of acceptable concentration (0.2%) of hydrocolloids on physico-chemical and sensory attributes of cow and/or buffalo milk whey beverages were evaluated against their corresponding controls. CMC or HMP did not affect the acidity of cow milk whey beverage, but in buffalo milk whey beverages, it was remarkably ($P<0.05$) affected by hydrocolloids. No significant ($P>0.05$) influence of CMC was observed on pH value of cow milk whey beverage, but it was significantly ($P<0.05$) decreased with addition of HMP. In buffalo milk whey beverage, both CMC and HMP remarkably ($P<0.05$) affected of the pH value. The specific gravity of cow and/or buffalo milk whey beverages was significantly ($P<0.05$) affected by the both hydrocolloids, the beverages were denser than that of their corresponding controls. Addition of CMC or HMP did not influence the moisture, fat and protein contents of cow and/or buffalo milk whey beverages. The concentrations of these characteristics were not statistically different ($P>0.05$) from that of their corresponding control. Addition of CMC or HMP to each of cow and/or buffalo milk whey beverages improved the sensory attributes like appearance/colour, odour/aroma, body/texture and taste/flavor. Their score was remarkably higher ($P<0.05$) than that of their corresponding controls. The use of CMC or HMP is concluded to be better to improve the density and sensory attributes of whey beverages without affecting the chemical characteristics of whey.*

Keywords*:Hydrocolloids,Carboxy-methylcellulose,high methoxyl pectin, cow, buffalo milk, whey beverage*

I. Introduction

Hydrocolloids are the macromolecular carbohydrates, added to many foodstuffs with the aim to achieve the appropriate rheological properties, to prevent syneresis or to increase the viscosity and stability of foodstuffs [1].Hydrocolloids have been widely used in the food industry for their gelling, thickening, emulsifying, dispersing, and stabilizing functions[2]. Their activity depends on the kind and concentration of hydrocolloids, temperature and process condition as well as on solid matter content and chemical composition of foodstuffs. They can be added in various combinations and phases of production and may have various final effects. The type of hydrocolloids largely determines overall appearance, texture and rheological properties of food [3].Whey, a liquid by-product of cheese or chhana, often disposedoffas a waste; is nowadays used as ingredient or foaming and emulsifying agent in food industry [4]. Whey is a protein-rich substance found in fermented dairy products.The main biological activities of proteins of whey liquid are cancer prevention, increase of glutathione levels and antimicrobial function [5-6]. Composition and characteristics of whey depend on the production technology of the end product and on the quality of the used milk. The conversion of whey into beverages through fermentation or without fermentation is one of the most attractive avenues for the utilization of whey.Beverages based on fruit and milk products are currently receiving considerable attention as their market potential is growing. Besides being delicious, these beverages are highly nutritious with good therapeutic characteristics. In terms of functionality, whey protein enhances protein content of beverage and improves its quality. These whey beverages are suitable for wide range of consumers from children to the oldest ones[7]. The watery characteristic of whey based beverage is caused by low solids content of liquid whey approximately 6%. Therefore, addition of hydrocolloids such as high methoxyl pectin (HMP), carboxy-methylcellulose (CMC) and alginate may be used to improve texture of product to be as homogenous as milk[8-9].In whey based beverages the stabilizers are used to modify the density and smoothness in order to stabilize the gel and prevent syneresis.Therefore, this study was conductedto evaluate the effect of hydrocolloids on the physico-chemical characteristics and to examine the effect of hydrocolloids on the sensory quality of whey beverage.

II. Materials And Methods

The study was carried out to produce the whey beverages from cow and buffalo milk. A total of two experiments were conducted at the Department of Animal Products Technology, Sindh Agriculture University Tandojam, and in each experiment the whey was prepared according to the method as reported by Krasaekoopt and Cabraal[10] with small modifications. The milk received at the laboratory was filtered through muslin cloth to remove any visible particles and thereafter heated to 93°C. After cooling at 70°C in circulating mains water, a coagulant (i.e. citric acid @ 10%) was added. It was stirred continuously till coagulation occurred. After keeping coagulum undisturbed for 30 minutes, it was strained through muslin cloth, and whey thus obtained was used for the preparation of whey beverages.

2.1 Preparation of whey beverages

In the first experiment a total of three trials were conducted, and in each trial, whey prepared from cow milk or buffalo milk was distributed into nine parts. Thereafter these were treated with cane sugar (CS) and two hydrocolloids Carboxy-methylcellulose (CMC) and high methoxyl pectin (HMP) with different combinations to obtain acceptable products with treatment combinations as shown in Table1.In brief, the whey was heated to 45°C and cane sugar and hydrocolloids were added. After thorough mixing, the mixture was filled into sterile screw caped bottles and pasteurized at 73°C for 15 seconds. Products were cooled and stored at4°C and was presented to judges for sensory evaluation[11].In the second experiment, on the basis of sensory evaluation the most acceptable two products as per combinations shown in Table2were selected for further studies. A total of three trials each in triplicate batches were conducted and analyzed for physico-chemical characteristics and sensory attributes.

2.2Physico-chemical characteristics

Titratable acidity, specific gravity, moisture andash content were determined according to the method[12], the pH values were determined by using pH meter (Model HI, Hanna Instruments, Italy),fat was determined by Gerber method[13] andprotein content was determined by the method as described by British Standards Institution[14]

2.3 Sensory evaluation

Sensory characteristics were analyzed according to the hedonic scale of 10 for appearance/color, 10 for odour/aroma, 30 for body/texture and 45 for taste/flavor[15].

2.4 Statistical analysis

The data were analyzed according to the statistical procedure of analysis of variance (ANOVA), and in case of significant differences, the means were further computed using least significant difference (LSD) at 5% level of probability through computerized statistical package i.e. Student Edition of Statistix (SXW), version 8.1 (Copyright 2005, Analytical software, USA).

Table-1 Treatment combinations for the whey beverages from cow and buffalo milk with addition of different concentrations of hydrocolloids

Batch	Type of hydrocolloids	Percent of hydrocolloids in		Percent of sugar
		Cow milk whey	Buffalo milk whey	
A (control)	No hydrocolloids	0.0	0.0	6.0
B	Carboxy methylcellulose	0.1	0.1	
C		0.2	0.2	
D		0.4	0.4	
E		0.6	0.6	
F	High methoxyl pectin	0.1	0.1	
G		0.2	0.2	
H		0.4	0.4	
I		0.6	0.6	

Table-2 Treatment combinations for the whey beverages from cow and buffalo milk with addition of hydrocolloids (0.2%)

Hydrocolloids	Percent of hydrocolloids in		Percent of sugar
	Cow milk whey	Buffalo milk whey	
Control	0.0	0.0	6.0
Carboxy methylcellulose	0.2	0.2	
High methoxyl pectin	0.2	0.2	

III. Results

3.1 Experiment-I

Under 1st experiment, three preliminary trials on the whey beverages were conducted and the beverages were successfully prepared with the addition of cane sugar and two hydrocolloids (i.e. CMC and Pectin) with different concentrations.The results in Table-3 revealed that average score rated for whey beverages prepared from cow milk with CMC, 0.1% (6.99 ± 0.14), 0.4% (6.94 ± 0.23) and 0.6% (6.61 ± 0.31) and HMP, 0.1% (6.83 ± 0.22), 0.4% (6.39 ± 0.41) and 0.6% (5.83 ± 0.44) was not significantly different (P>0.05) from that of control whey beverage (6.55 ± 0.20), however, remarkable differences (P< 0.05) were observed in the average score of 0.2% CMC (8.27 ± 0.13) and 0.2% HMP (8.16 ± 0.20) compared to that of control group (6.55 ± 0.20).While the average score rated for whey beverages prepared from buffalo milk with CMC 0.6% (6.66 ± 0.14) and HMP 0.1% (6.61 ± 0.38), 0.4% (6.11±0.38) and 0.6% (6.05±0.23) was not significantly different (P> 0.05) from that of control whey beverage (6.27 ± 0.37), whereas, a remarkable difference (P< 0.05) was observed in the average score of CMC, 0.1% (7.22 ± 0.11), 0.2% (8.33±0.17), 0.4% (7.22±0.25) and HMP, 0.2% (8.22 ± 0.11) compared to that of control group (6.27 ± 0.37). Moreover, whey beverages with 0.2% CMC and 0.2% HMP received the highest score among the other concentrations of corresponding hydrocolloids.

Table-3 Overall acceptability (score) of cow and/or buffalo milk whey beverages with addition of different concentrations of hydrocolloids

Hydrocolloids	Concentration (%)	Acceptability score (maximum 9)	
		Cow milk Whey beverage	Buffalo milk Whey beverage
Control *	0.0	6.55^{bc}	6.27^{c}
Carboxy methylcellulose	0.1	6.99^{b}	7.22^{b}
	0.2	8.27^{a}	8.33^{a}
	0.4	6.94^{b}	7.22^{b}
	0.6	6.61^{bc}	6.66^{bc}
High methoxyl pectin	0.1	6.83^{b}	6.61^{bc}
	0.2	8.16^{a}	8.22^{a}
	0. 4	6.39^{bc}	6.11^{c}
	0.6	5.83^{c}	6.05^{c}
LSD (0.05) ± SE		0.79 ± 0.39	0.75 ± 0.37

Means with different letters in column or row varied significantly from one another.
*No hydrocolloids

3.2 Experiment II

Under experiment-II, the two most acceptable whey beverages, among the products in experiment-I, were prepared and analyzed for physico-chemical and sensory characteristics.

3.3 Physical characteristics of whey beverages

Physical characteristics of cow and buffalo milk whey beverages with addition of hydrocolloids (with 0.2% selected concentration) compared to control (without hydrocolloids) was observed and results are shown in Table-4. The average acidity percentage in cow milk whey beverages with 0.2% CMC (0.30 ± 0.01%) and 0.2% HMP (0.29 ± 0.01%) was relatively similar (P>0.05) to that of control (0.27 ± 0.01%). However, the buffalo milk whey beverages with 0.2% CMC (0.22±0.01%) and 0.2% HMP (0.25 ±0.03%) was not significantly different (P>0.05) from one another, but remarkably different (P< 0.05) from their corresponding control (0.18±0.01%). It was further observed that average acidity was significantly (P< 0.05) higher in cow milk whey beverages (with or without hydrocolloids) compared to that of buffalo milk whey beverages without hydrocolloids and with CMC.

The average pH values in control cow milk whey beverage (5.16 ± 0.03) and with 0.2% CMC (5.19 ± 0.03) were not different (P> 0.05) but significantly (P< 0.05) higher than that of cow milk whey beverages with 0.2% HMP (4.99 ± 0.01). However, the pH value of buffalo milk whey beverage with 0.2% CMC (5.13 ± 0.03) was significantly higher followed by control (5.02 ± 0.03) and with 0.2% HMP (4.93 ± 0.02). Further it was observed that the pH of whey beverages with 0.2% CMC (cow or buffalo milk) and control cow milk whey beverages was relatively similar (P> 0.05) and with 0.2% HMP (cow or buffalo milk) and control buffalo milk whey beverages was also not different (P>0.05) from one another.

The average specific gravity of cow milk whey beverage with 0.2% CMC and 0.2% HMP was relatively similar (P> 0.05) i.e. 1.052 ± 0.001 but significantly higher (P< 0.05) than that of control cow milk whey beverages (1.048±0.002). In case of buffalo milk whey beverages the specific gravity was found

remarkably higher (P< 0.05) for whey beverage with 0.2% CMC (1.053 ± 0.001) than that of control (1.048±0.01), but it was relatively similar (P> 0.05) to whey beverage with 0.2% HMP (1.051±0.01). Moreover, the average specific gravity was similar (P> 0.05) in both control cow and buffalo milk whey beverages, but it was increased with similar (P> 0.05) trend in both with addition of hydrocolloids.

Table-4 Physico-chemical characteristics of cow and buffalo milk whey beverage with addition of hydrocolloids

Hydrocolloids (0.2%)	Titratable acidity (%)		pH values		Specific gravity		Moisture content (%)		Fat content (%)		Protein content (%)		Ash content (%)	
	Cow	Buffalo	Cow	Buffalo	Cow	Buffalo	Cow	Buffalo	Cow	Buffalo	Cow	Buffalo	Cow	Buffalo
Control*	0.27^{ab}	0.18^{d}	5.16^{a}	5.02^{b}	1.048^{b}	1.048^{b}	88.22^{ab}	86.97^{b}	0.08^{a}	0.36^{a}	0.36^{a}	0.39^{a}	0.26^{d}	0.40^{d}
Carboxy methylcellulose	0.30^{a}	0.22^{c}	5.19^{a}	5.13^{a}	1.052^{a}	1.053^{a}	87.67^{b}	86.89^{b}	0.08^{a}	0.27^{a}	0.28^{b}	0.35^{ab}	1.33^{c}	1.46^{bc}
High methoxyl pectin	0.29^{a}	0.25^{bc}	4.99^{bc}	4.93^{c}	1.052^{a}	1.051^{ab}	89.86^{a}	87.37^{b}	0.10^{a}	0.32^{a}	0.37^{a}	0.36^{a}	1.66^{ab}	1.80^{a}
LSD (0.05) SE±	0.03 ±0.01		0.07 ±0.03		0.003 ±0.002		2.09 ±1.02		0.31 ±0.15		0.07 ±0.03		0.28 ±0.14	

***** No hydrocolloids

3.4 Chemical components of whey beverages

The chemical components of cow and buffalo milk whey beverages with addition of hydrocolloids (with 0.2%) compared to control (without hydrocolloids) was examined and results are presented in Table-4. The average moisture content in cow milk whey beverage with 0.2% HMP (89.86 ± 0.84%) was significantly higher (P<0.05) than that of whey beverages with 0.2% CMC (87.67±0.77%) and control cow milk whey beverage (88.22 ± 0.61%) was statistically not different (P> 0.05) from whey beverage with 0.2% CMC or 0.2% HMP. In case of buffalo milk whey beverages the moisture content was statistically similar (P> 0.05) in control (86.97 ± 0.59%), with 0.2% CMC (86.89 ± 0.67%) and with 0.2% HMP (87.37 ± 0.81%). Further it was found that average moisture content of cow milk whey beverages (with or without hydrocolloids) was slightly higher than that of the buffalo milk whey beverages but statistically there was no significant differences (P>0.05) among them, except with 0.2% HMP added cow milk beverage under which it was significantly (P<0.05) higher than all the other whey beverages.

The average fat content of control cow milk whey beverage and with 0.2% CMC was relatively similar i.e. 0.08 ± 0.02 and 0.08 ± 0.01%, respectively but it was slightly higher in beverage with addition of 0.2% HMP (0.10 ± 0.01%), while average fat content of control buffalo whey beverage (0.36 ± 0.16%) was slightly higher followed by whey beverage with 0.2% HMP (0.32 ± 0.16%) and 0.2% CMC (0.27 ± 0.14%). However, statistical analysis (ANOVA) revealed no significant differences (P> 0.05) between the means of all types of whey beverages (LSD; 0.05).

The average protein content in whey beverage with 0.2% HMP (0.37 ± 0.01 %) was slightly higher than that of control cow milk whey beverage (0.36 ± 0.02%) but statistically similar (P> 0.05) to one another, while significantly higher (P< 0.05) than that of whey beverage with 0.2% CMC (0.28 ±0.03%). In case of buffalo whey beverage the average protein content was slightly higher in control (0.39 ±0.02%), followed by whey beverage with 0.2% HMP (0.36 ± 0.01%) and with 0.2% CMC (0.35 ± 0.02%) but statistically not different (P> 0.05) from one another. It was further observed that regardless the average protein content was slightly higher in buffalo milk whey beverages (with or without hydrocolloids) than that of the cow milk whey beverages (with or without hydrocolloids) the difference among them was not significant (P> 0.05).

The average ash content in whey beverage with 0.2% HMP (1.66±0.04%) and 0.2% CMC (1.33±0.15 %) was remarkably higher (P<0.05) than that of control (0.26±0.04%). The average ash content in 0.2%HMP buffalo whey beverage (1.80±0.03%) was significantly higher (P< 0.05) than that of whey beverage with 0.2% CMC (1.46 ± 0.16%) and control (0.40±0.07%). Ash content of cow milk beverage with 0.2% CMC and with 0.2% HMP was statistically not different (P>0.05), but significantly higher (P<0.05) than that of control cow milk whey beverage. In case of buffalo milk whey beverage, the ash content in whey beverage with 0.2% HMP was significantly higher (P<0.05) followed by 0.2% CMC beverage and control beverage. Further it was observed that although control buffalo milk whey beverage was significantly higher (P<0.05) in ash content than that of control cow milk whey beverage, the 0.2% CMC and 0.2% HMP buffalo milk beverage was not statistically different (P>0.05) from their corresponding control.

3.5 Sensory characteristics of whey beverage

The score rated for sensory characteristics of cow and buffalo milk whey beverages with addition of hydrocolloids compared to control was rated by panel of judges is shown in Table 5. The appearance/colour of cow milk whey beverage with 0.2% CMC (7.55 ± 0.18) and with 0.2% HMP (7.33 ± 0.12) received the significantly (P< 0.05) higher score than that of control cow milk whey beverage (6.66± 0.08). Similarly the average score for appearance/colour was significantly higher (P< 0.05) in case of buffalo milk whey beverage with hydrocolloids (i.e.7.50 ± 0.14 with 0.2% CMC and 7.61 ±0.16 with 0.2% HMP) than that of control (6.72 ±

0.11), while score rated for cow and/or buffalo milk whey beverage with hydrocolloids was statistically similar (P> 0.05) with one another.

Table- 5 Sensory evaluation (score) of cow and buffalo milk whey beverageswith addition of hydrocolloids

Hydrocolloids (0.2%)	Appearance/colour score (maximum 10)		Odour/aroma score (maximum 10)		Body/texture score (maximum 30)		Taste/flavor score (maximum 45)	
	Cow	Buffalo	Cow	Buffalo	Cow	Buffalo	Cow	Buffalo
Control*	6.66^{b}	6.72^{b}	6.22^{d}	6.56^{cd}	18.61^{c}	23.05^{b}	24.83^{c}	33.22^{b}
Carboxy methylcellulose	7.55^{a}	7.50^{a}	7.17^{ab}	7.56^{a}	24.83^{ab}	25.83^{a}	35.50^{ab}	37.28^{a}
High methoxyl pectin	7.33^{a}	7.61^{a}	6.84^{bc}	7.58^{a}	23.22^{b}	26.06^{a}	34.00^{b}	37.61^{a}
LSD (0.05) SE±	0.39 ±0.19		0.44 ±0.21		2.02 ±0.99		2.85 ±1.39	

***** No hydrocolloids

The average score received for odour/aroma of cow milk whey beverages with 0.2% CMC (7.17 ± 0.14) and with 0.2% HMP (6.84 ± 0.24) was significantly (P< 0.05) higher than that of control cow milk whey beverage (6.22± 0.07). Simultaneously the average score for odour/aroma was significantly higher (P< 0.05) in case of buffalo milk whey beverages with 0.2% CMC (7.56± 0.14) and 0.2% HMP (7.58 ± 0.19) than that of control (6.56 ± 0.07). While score rated for cow and/or buffalo milk whey beverage with hydrocolloids was statistically similar (P> 0.05) to each another except with HMP of cow milk whey beverage. Further it was analyzed that the average score of odour/aroma was relatively similar (P> 0.05) for control cow or buffalo milk whey beverages and in case of addition of 0.2% CMC score for cow milk whey beverages was also similar (P> 0.05) with buffalo milk whey beverages but it was lower (P< 0.05) for cow milk whey beverages with 0.2% HMP.

The body/texture of cow milk whey beverage with 0.2% CMC (24.83 ± 0.62) and with 0.2% HMP (23.22 ± 0.70) was received the average score as significantly (P< 0.05) higher than that of control cow milk whey beverage (18.61± 1.11). Similarly the average score for body/texture was significantly higher (P< 0.05) in case of buffalo milk whey beverage with 0.2% CMC (25.83 ± 0.40) and 0.2% HMP (26.06 ± 0.68) than that the control (23.05 ± 0.57).Moreover, it was evaluated that the average score of body/texture for cow milk whey beverages with hydrocolloids was relatively similar (P> 0.05) with the buffalo milk whey beverages (with or without hydrocolloids) but control cow milk whey beverages was significantly lower (P< 0.05).

The average score received for taste/flavour of cow milk whey beverage with 0.2% CMC (35.50 ± 1.59) and with 0.2% HMP (34.00± 1.42) was significantly (P< 0.05) higher than that of control cow milk whey beverages (24.83± 0.61). Similarly the average score for taste/flavour was significantly higher (P< 0.05) in case of buffalo milk whey beverage with 0.2% CMC (37.28± 0.72) and 0.2% HMP (37.61 ± 0.43) than that of control (33.22 ± 0.45), while score rated for cow and/or buffalo milk whey beverage with hydrocolloids was statistically similar (P> 0.05) to each another except with HMP of cow milk whey beverage. Further it was analyzed that the average score of taste/flavour for control cow milk whey beverages was significantly (P< 0.05) lower than that of buffalo milk whey beverages (with or without hydrocolloids) but cow milk whey beverages with hydrocolloids received similar (P> 0.05) score for taste/flavour to that of buffalo milk whey beverages (with or without hydrocolloids).

IV. Discussion

The hydrocolloids, such as, Carboxy-methylcellulose (CMC) and high methoxyl pectin (HMP), are often added to the whey base to enhance or maintain the appropriate properties including appearance, consistency, texture, mouth feel and rheological properties [3]. The hydrocolloids are used as stabilizer, binder and thickening agents in food industry. In the first experiment of the present study, whey beverages from cow and/or buffalo milk whey with different concentrations of hydrocolloids were prepared and evaluated for overall acceptability to select the product with more acceptable concentration of hydrocolloids. It was noted that both cow and buffalo milk whey beverage with 0.2% CMC or 0.2% HMP perceived remarkably (P< 0.05) higher acceptability score compared to that of control and other whey beverages with 0.1%, 0.4% and 0.6% concentrations of CMC or HMP. Present findings regarding the acceptability profile of cow and buffalo milk whey beverages are confirmed in a study[10] that the cow or buffalo milk whey beverages with 0.2% CMC or HMP perceived the better score, while higher concentration of these declined the preference score in all the sensory attributes.

In the present study, the acidity in cow milk whey beverages with 0.2% CMC (0.30 ± 0.01%) and/or with 0.2% HMP (0.29 ± 0.01%) was not comparable (P>0.05) with their corresponding control. While addition of these hydrocolloids (i.e. 0.2% CMC or HMP) to buffalo milk whey considerably (P<0.05) changed the acidity of beverages. Moreover, the acidity in cow milk whey beverages (with or without hydrocolloids) was

significantly higher than that of buffalo milk whey beverages. It could be argued that raw material has significant impact on the end product[16], and in the present study, whey as basic ingredient of whey beverages was rather high in acidity from cow milk compared to that of buffalo milk. The concentration and type of added hydrocolloids had no influence on the acidity of whey after fermentation/acidification in all types of milk[10]. Similarly, no apparent differences in titratable acidity of the whey beverages between control product and that containing acai pulp were observed[17]. The hydrocolloids (i.e. CMC and HMP) had considerable ($P<0.05$) influence on pH values of cow or buffalo milk whey beverages with exception of CMC in cow milk whey beverage. pH values were rather high in CMC added and low in HMP added buffalo milk whey beverages than that of their controls. The results of present study is not in agreement with the findings that type and concentration of hydrocolloids had no considerable effect on pH values of the products before and after fermentation[10], while little variation was observed[18]. Addition of hydrocolloids (CMC or HMP) in cow milk and/or buffalo milk whey significantly ($P<0.05$) affected the specific gravity of whey beverages. The whey beverages were denser than control. The reason behind this could be that hydrocolloids (with exception of gelatin) are polysaccharides or complex sugars and after addition of these in water/watery liquid, the water gathers around, attracts to the sugar units and forms a layer of water with restricted movement. This ability to organize and control water, gives the hydrocolloids to thicken and form gel. Moreover, both of the hydrocolloids did not show any significant ($P>0.05$) influence either on cow milk whey or buffalo milk whey.

Hydrocolloids (CMC or HMP) either in cow milk or buffalo milk whey did not affect the moisture content of beverages. It was reported thatthere was no any noticeable difference ($P> 0.05$) in total solids /moisture content of the whey beverages when added with acai pulp[7].The concentration of moisture in hydrocolloids (CMC or HMP) added beverages were slightly varied from that of control. This could be attributed with the composition and characteristics of whey which depend on the quality of milk from which it has been made, and also on the production technology of the end products. Moreover, they observed high moisture content (approximately 93%) in liquid whey[7].No significant influence ($P> 0.05$) of hydrocolloids (CMC or HMP) was observed on fat content of whey beverages. Generally, the concentration of fat in whey liquid depends upon the processing conditions that have greater influence over the whey components. For instance, cheese whey, paneer whey or chhana whey are produced with different processing conditions and the fat content in these types of whey liquids varied greatly i.e. 0.2 ± 0.06, 0.01 and 0.19% in cheese, paneer and chhana whey, respectively[19-20].As the hydrocolloids (CMC or HMP) added with whey liquid were polysaccharides or complex sugarsthat only change the nature of liquid, but not the fat content. The peach-flavoured and strawberry-flavoured beverages exhibited relatively similar ($P>0.05$) fat content[18]. The effect of hydrocolloids (i.e. CMC or HMP) on protein content of cow milk or buffalo milk whey beverages was not comparable ($P>0.05$). This is because the protein contents in these beverages were originated only from whey (cow milk or buffalo milk whey) but not from hydrocolloids (i.e. CMC or HMP) which are polysaccharides or complex sugars and has no significant influence on protein content. Moreover, the whey for present study was produced with same processing conditions from cow or buffalo milk, where type of milk showed slight variation ($P>0.05$) in protein content of final products. The addition of hydrocolloids (CMC or HMP) in cow milk or buffalo milk whey resulted the higher ash content compared to that of their corresponding control. The results further revealed that ash content in buffalo milk whey base beverages was considerably higher in cow milk whey beverages indicating the great influence of type of milk.

The appearance/colour of cow and buffalo milk whey beverages with 0.2% CMC and with 0.2% HMP was comparatively ($P< 0.05$) better than that of control cow and buffalo milk whey beverages. The sensory characteristics of whey beverage from buffalo milk were improved when 0.2% CMC was added;[10], however, the fermented whey beverage from cow milk was liked very much. Further they argued that the HMP provided the highest preference scores of color, while CMC seems to be suitable for the appearance/colour of fermented whey beverage from buffalo milk. Moreover, the similar acceptability score for the peach beverage and the strawberry beverage was observed[18]. Present findings revealed that the average score for odour/aroma of cow and buffalo milk whey beverages with 0.2% CMC and with 0.2% HMP was relatively similar ($P>0.05$) and both of these were significantly ($P< 0.05$) higher than that of their corresponding controls. Thehydrocolloids provide pleasant aroma to the whey beverage and among these, CMC seems to be suitable for fermented buffalo milk whey beverage[10]. In addition aroma of whey beverage could also be improved with addition of peach or strawberry fruit and among this peach have better aroma to whey beverage[3]. The cow and/or buffalo milk whey beverages perceived the significantly ($P< 0.05$) better body/texture than that of the control. The results of the present study are in accordance with the findings that the hydrocolloids in dairy industry are mainly used to improve the texture of the whey beverage [21].While it was also illustrated that the HMP and CMC in buffalo milk whey beverage provide better texture. The taste/flavour of cow and/or buffalo milk whey beverage with 0.2% CMC and with 0.2% HMP was significantly ($P< 0.05$) better than the control. It was also observed that the HMP in cow milk whey beverage provided the highest preference to flavor, whereas CMC seems to be suitable for fermented buffalo milk whey beverage[10].

Itwas concluded that cow and buffalo milk whey beverages with addition of hydrocolloids (CMC and HMP) were more dense ($P<0.05$) than control and were better insensory characteristics.

References

[1]. Hegedusic V., Z.HercegandR.Suzana, Rheological properties of carboxy methyl-cellulose and whey model solutions before and after freezing. *Food TechnolBiotechnol38*, 2000, 19-26.

[2]. Dluzewska E, M. PanasiewiczandK.Leszczyski, Effect of gum arabic and modified starch on stability of beverage emulsions. *Electronic Journal of Polish Agricultural Universities 7(2),*2004, 10.

[3]. Gaviria P.M, D.A.RestrepoandH.M.Suarez, Use of dairy beverages in hydrocolloids kumis type. *Vitae17,*2010, 29-36.

[4]. JiT.andZ.U.Haque, Cheddar whey processing and source. I. Effect on composition and functional properties of whey protein concentrates. *Int J Food SciTechnol38,*2003, 453-461.

[5]. Valli C. andW. B.Traill, Culture and food: A model of yogurt consumption in the EU. *Food Qual Prefer16,*2005, 291-304.

[6]. Madureira A. R., C. I.Pereira, A. M. P.Gomes, M. E.Pintado and F. X .Malcata, Bovine whey proteins overview on their main biologicalproperties. *Food Res Int40,*2007, 1197-1211.

[7]. Jelicic I., B. Rajka andT.Ljubica, Whey-based beverages- a new generation of dairy products. *Mljekarstvo58,*2008, 257-274

[8]. Driesen F. M. andM.G.Van Den Berg, New developments in whey drinks. *Bulletin Int Dairy Federation,250,*1990, 11-19.

[9]. Sienkiewicz T.andC. L.Riedel, Whey and whey utilization. Verlag Th. Mann. Gelsenkirchen-Buer, Germany, 1990.

[10]. Krasaekoopt W. andT. L.Cabraal, Effect of hydrocolloids on sensory properties of the fermented whey beverage from different types of milk. *AssumpUni JTechnol14,*2011, 253-258.

[11]. Naik Y.K., A.Khare, P.L.Choudhary, B.K.Goel andA.Shrivastava, Studies on physico-chemical and sensory characteristics of whey based watermelon beverage. *Asian J Res Chem2,*2009, 57-59.

[12]. AOAC, Dairy products. In: Official Methods of Analysis. Association of Official Analytical Chemists Inc. Gaithersburg, U.S.A.2000.

[13]. James C.S., Determination of fat contents of dairy products by the Gerber method. In Analytical chemistry of food.(BlackiAcademic and Professionals, an imprint of Chapman and Hall, Glasgow, UK, 1995), 93-95.

[14]. BSI, Determination of nitrogen content of liquid milk. In: Methods of chemical analysis of liquid milk and cream. BSI: 1741, British Standards Institution, London, UK, 1990.

[15]. Nelson J.A. andG.M.Trout, Judging of dairy products, 4th. Ed.(AVI Publishing Company Inc. Westport, Connecticut, 1981), 296-97.

[16]. Harding F., Milk quality. (Blackie Academic and Professional, an imprint of Chapman and Hall, Glasgow, UK, 1995),138-139.

[17]. Zoellner S. S., A.G.CruzandJ.A.F.Faria, Whey beverage with acai pulp as a food carrier of probiotic bacteria. *Austr J Dairy Technol64,*2009, 165- 169.

[18]. Tranjan B. C., A. G.Cruz, E. H. M.Walter, J. A. F.Faria, H. M. A.Bolini, M. R. L.MouraandL. M. J.Carvalho, Development of goat cheese whey- flavoured beverages. *Int J Dairy Technol62,*2009, 438–443.

[19]. Goyal N. andD.N.Gandhi, Comparative analysis of Indian paneer and cheese whey for electrolyte whey drink. *World J Dairy Food Sci4,*2009, 70-72.

[20]. Sakhale B.K., V.N.PawarandR.C.Ranveer, Studies on the development and storage of whey based RTS beverage from Mango *cv. Kesar*. *J Food Process Technol3,*2012, 148-150.

[21]. Syrbe A., W. J.Beuer,H.Klostermeyer, Polymer science concepts in dairy systems - An overview of milk protein and food hydrocolloid interaction. *Inter Dairy J8,*1991, 79-93.