UTILIZATION OF WHEY AS A COOKING SYRUP MEDIUM IN THE PREPARATION OF CHHANA BASED SWEET- '*RASOGOLLA*'

Pushpa P. Acharya
Sandeep K. Kanth

ABSTRACT

***Rasogolla* was prepared in laboratory by using standardized pasteurized milk produced from Biratnagar Milk Supply Scheme (BMSS), Dairy Development Corporation (DDC), Biratnagar. It was analyzed for sensory, chemical, biochemical and microbiological attributes. The chemical composition of *rasogolla* prepared on whey (neutralized and unneutralized) as a cooking medium in terms of moisture, fat, protein, sucrose and total solid were found to be 56.6, 8.1, 6.25, 44.11 and 59.27%, respectively. The pH of freshly prepared *rasogolla* was 6.2. Total plate count (TPC), Yeast & mold (Y&M) and Coliform counts of the fresh *rasogolla* sample were found to be 0.74×10^3, 0.23×10^2 and 0.1×10^2 cfu/g, respectively.**

Keywords: Chemical and microbiological analysis, Dairy milk, Sensory parameters, Storage of *rasogolla*, Whey utilization.

The *rasogolla* cooked in un-neutralized whey syrup medium did not significantly differ with neutralized whey syrup medium in terms of sensory and microbiological qualities. The color and appearance score was significantly lowered as a sucrose level in syrup increased in un-neutralized whey medium, whereas sucrose level 50% in neutralized whey, gave higher color score than other treatment conditions. Body and texture, smell and taste did not significantly ($p<0.05$) vary as the sucrose level increased in the two medium. The neutralized whey with 50 % sucrose is recommended as a proper cooking medium for *rasogolla* making which save 5 % of the sugar with improving body and texture. The change in chemical composition of *rasogolla* such as free fatty acids (FFAs), soluble nitrogen and acidity were increased significantly as storage period increased.

INTRODUCTION

The *rasogolla* is one of the indigenous and most popular milk based sweets in eastern India and Nepal. It is chhana based sweet mainly prepared from cow and buffalo milk. *Chhana* is obtained from heated milk to 95°C and coagulating it means of suitable coagulant after lowering temperature of 70°C followed by hanging the coagulated mass in muslin cloth for easier drainage of the whey. Chhana thus is kneaded with or without addition of wheat flour and sodium bicarbonate and converted into the round balls. These balls are cooked in whey sugar syrup and kept overnight for development of texture (Singh & Ray, 1977). The art of *rasogolla* preparation has been confined in hands of skilled *Halwais* in a batch process. Its demand is increasing day by day, so looking to the future demand, it is now being felt necessary to develop a continuous

manufacturing technology for qualitative commercial production. The effect of processing parameters on the final quality of *rasogolla* and their optimization has to be done in order to design the equipment (Goel & Agrawal, 1994).

Total milk production in the fiscal year 2000/2001 was 1124132 MT (SPB, 2002). About 87 % of the total milk production is for home consumption; farmers sell only 13 % (about 146137 MT) of their milk production mainly through informal channels. Farmers sell more than half of their milk around the major urban markets and in areas where the Dairy Development Corporation (DDC) collects milk. The formal sector, comprising DDC and private dairies, buys about 20,000-25,000 tons every day (about 0.1 % of total milk production (HMG, 1991).

Milk holiday has come up as a major problem for milk producing farmers, which desperate the milk producers and creates negative impact on milk production (Thapa, 1999). It is essential to provide an idea of using surplus milk production by using simple techniques either by diversification of products or by increasing shelf life of milk. *Rasogolla* production is a simple and easier technique of product diversifications. It is also essential to provide knowledge about the by-product utilization.

It is estimated that about 50-55 percent of local milk produced in Nepal is converted into variety of traditional milk products usually acid coagulation. These processes have largely been unchanged being in the hand of *Halwais*, the traditional milk based sweet makers. Whey is the liquid remaining after removal of casein and fat from the milk in the process of chhana based sweets and cheese or paneer making. It contains most of the lactose, salts and water soluble proteins of the milk. It comprises about 80-90 percent of total volume of milk entering the process and contains about 50 percent of the nutrients in the original milk. There has a great environmental pollution problem created in disposing the whey openly in the society. So the study is mainly focused on the proper utilization of it as a cooking whey syrup medium in the preparation of *rasogolla*. The main objectives of present work is to utilize the milk by-product whey in the syrup as a cooking medium and effect of whey and sucrose levels in the cooking time and chemical composition of *rasogolla*.

MATERIALS AND METHODS

Standard pasteurized milk (3 % fat, 8 % solid-not-fat) produced from BMSS, DDC, Biratnagar, was taken from the local booth of Dharan for the preparation of *rasogolla*. The commercial grade citric acid was available in laboratory used as a coagulant. Cane sugar and wheat flour were brought from local market Dharan.

The cooking medium was prepared by mixing plain *Chhana* whey (0.21 % lactic acid) un-neutralized (W_1) with S_1(45), S_2(50), S_3(55) percent sucrose (w/w) and neutralized whey (0.12 % lactic acid) with sodium hydroxide (W_2) with same level of sucrose as above. In each treatment 55 % sugar syrup was used as control.

Rasogolla was prepared in the laboratory by using the method given as follows. The standard milk with acidity (o.16 %) was heated up to 95°C and immediately cooled to 70°C. Then the citric acid (1 %) solution was added slowly with constant stirring till clean separation of whey and casein curd. Then it was left for 15 minutes for clear separation of curd from whey. The separated curd (*Chhana*) was mixed with small quantity (2.5 g) of wheat flour (*maida*). The chhana had 55 % moisture. The chhana was manually kneaded for 15-20 minutes and converted in to small balls. The weight of each ball was 10.46 g. Then the cooking medium made as previous was boiled for 20 minutes. The chhana balls were dipped in a cooked whey syrup medium for about 16 h at 30°C. Lastly, *rasogolla* having 56.6 % moisture content was prepared. It was packed in plain metal cans and stored at room temperature. It was stored up to 10 days and used for chemical, sensory and microbiological analysis.

Chemical analyses such as protein, free fatty acids (FFAs), acidity of *rasogolla* sample were determined by standard procedure (Egan *et al.,* 1981). Total solids, fat, ash content and titratable acidity were determined by AOAC, (1990). Moisture content was determined as the standard procedure given in Jul-Overlay (1986). The pH of the sample was determined as follows. The *rasogolla* sample (10g) was ground into fine paste with 10 ml distilled water and immersed a glass electrode already standardized with buffer solution of pH 4 and 9.2 at 25°C in each reading.

Sensory analysis of *rasogolla* samples was carried out by semi-trained panelist. Ten panelists were subjected the final product and asked about the color and appearance, body and texture, taste, smell and total score on the basis of triangle test given in Ranganna (1994). The microbiological analyses of samples were performed as per the procedure described in Jul-Overlay (1986).

Statistical analyses of all the data obtained in the experiment were conducted by the program known as Genstat developed by Lawes Agricultural Trust (1995). From this, mean, ANOVA at 5 % significance, LSD and interaction effects of treatments were obtained.

RESULTS AND DISCUSSION

CHEMICAL AND MICROBIOLOGICAL ANALYSIS OF *RASOGOLLA*

The chemical composition of *rasogolla* prepared at laboratory in terms of moisture, fat, protein (%N × 6.38), sucrose and total solids were found to be 56.6, 8.1, 6.25, 44.11 and 57.27 percent, respectively. The pH of freshly prepared samples was found to be 6.2.

The quality of *rasogolla* depends on the quality of milk used. Cow milk is normally used for *rasogolla* preparation because it can produce soft, smooth and spongy texture (Mitra *et al.,* 1967) while buffalo milk produces very hard, brittle, chewy and coarse *rasogolla* which is not liked by the consumers (Date *et al.* 1958). *Rasogolla* cooked in whey mixed syrup was found to be softer than that with sucrose syrup alone. It might be due to whey protein matrix formed. Total plate count (TPC), yeast & mold (Y&M) and coliform counts of the fresh *rasogolla* sample were found to be 0.74×10^3, 0.23×10^2 and 0.1×10^2 cfu/g, respectively.

Table 1: Effect of whey, sucrose syrup levels on the cooking time of *rasogolla*

Cooking media	Final (°B)	Cooking time(min)
1.a. Chhana whey unneutralized (45 % w/w sucrose)	55	28*
b. Chhana whey unneutralized (50% w/w sucrose)	60	21*
c. Chhana whey unneutralized (55 % w/w sucrose)	65	17+
2.a. Chhana whey neutralized (45 % w/w sucrose)	55	27*
b. Chhana whey neutralized (50% w/w sucrose)	60	20
c. Chhana whey neutralized (55 % w/w sucrose)	65	15+
3 Sugar syrup (control)	55	19

The values are the means of three replications. The values in a column having (*) superscript had significantly higher value than control and (+) superscript significantly lower value than control by LSD.

Table 2: Effect of different whey sugar syrup medium on the chemical composition of *rasogolla*

Cooking media	Final (°B)	Composition of *rasogolla* (%)			
		Fat	Protein	Sucrose	T.S.
1.a.Chhana whey unneutralized(45 % w/w sucrose)	55	8.02^{+}	6.20^{+}	43.94*	59.19^{+}
b. Chhana whey unneutralized (50% w/w sucrose)	60	7.42^{+}	5.74^{+}	44.46*	58.55^{+}
c. Chhana whey unneutralized (55 % w/w sucrose)	65	8.18^{+}	6.37^{+}	44.28*	59.73^{+}
2.a. Chhana whey neutralized (45 % w/w sucrose)	55	8.10^{+}	6.25^{+}	44.11*	59.27^{+}
b. Chhana whey neutralized (50% w/w sucrose)	60	7.61^{+}	5.83^{+}	44.57*	58.79^{+}
c. Chhana whey neutralized (55 % w/w sucrose)	65	8.26^{+}	6.43^{+}	44.51*	59.95^{+}
3 Sugar syrup (control)	55	8.60	6.67	43.86	43.86

Values are the mean of three replicates. The values in a column having * superscript had significantly higher value than control and $^{+}$ superscript significantly lower value than control by LSD.

Table 3: Effect of whey and sucrose syrup medium in the cooking time and composition of *rasogolla*

Cooking syrup	Cooking time (min)	Chemical composition			
		Fat	Protein	Sucrose	T.S.
W_1	22	7.87^{a}	6.10^{a}	44.30^{a}	59.15^{a}
W_2	21	7.99^{b}	6.17^{b}	44.40^{b}	59.34^{b}
Sucrose Levels					
S_1	26	8.01^{c}	6.22^{c}	43.92^{c}	58.15^{c}
S_2	21	7.47^{d}	6.75^{d}	44.58^{d}	58.84^{d}
S_3	16	8.24^{e}	6.43^{e}	44.28^{e}	59.74^{e}
LSD					
W	0.992	0.009	0.013	0.024	0.035
S	0.992	0.009	0.013	0.024	0.035
WS	1.719	0.016	0.022	0.042	0.061

Values are the mean of ten semi-trained panelists. Means having the same superscript in a column did not differ significantly by LSD.

(***Notations:*** W_1 – un-neutralized chhana whey; W_2 - neutralized chhana whey, and S_1, S_2 and S_3 are 45, 50 and 55 % w/w sucrose levels in whey, respectively).

Table 4: Effect of different whey sucrose syrup medium on the sensory qualities of *rasogolla*

Channa whey as cooking medium	Final (°B)	Sensory score of *rasogolla*				
		Taste (Max. 15)	Smell (Max. 15)	Color and Appearance (Max. 20)	Body and Texture (Max. 45)	Total (Max. 100)
1 a. Unneutralized whey (45 % w/w sucrose)	55	18.67	15.00	18.40*	40.09	92.16
b. Unneutralized whey (50% w/w sucrose)	60	18.67	15.00	18.17*	42.46	94.30
c. Unneutralized whey (55 % w/w sucrose)	65	18.67	15.00	16.80	40.53	91.00
2 a. Neutralized whey (45% w/w sucrose)	55	18.67	15.00	17.90	40.63	92.20
b. Neutralized whey (50% w/w sucrose)	60	18.33	15.00	18.17*	41.83	93.33
c. Neutralized whey (55 % w/w sucrose)	65	19.33	15.00	17.23	40.07	91.63
3. Sugar syrup (control).	55	18.3	15.00	16.70	40.17	90.20

Values are the mean of three replications. The values in a column having (*) superscript had significantly higher value than control and (+) superscript significantly lower value than control by LSD.

Table 5: Effect of whey sucrose syrup medium on the sensory characteristics of *rasogolla*

Cooking syrup	Sensory score of *Rasogolla*				
	Taste (Max.15)	Smell (Max. 15)	Color and appearance (Max. 20)	Body and Texture (Max. 45)	Total Score (Max. 100)
Whey system					
W_1	18.67[a]	15.00[a]	17.79[a]	41.03[a]	92.49[a]
W_2	18.78[a]	15.00[a]	17.77[a]	40.84[a]	92.39[a]
Sugar levels					
S_1	18.67[a]	15.00[a]	18.17[a]	40.20[a]	92.03[a]
S_2	18.55[a]	15.00[a]	17.73[ab]	41.72[a]	93.01[a]
S_3	19.00[a]	15.00[a]	16.85[c]	40.20[a]	91.05[a]
Least significantly different ($P<0.05$)					
W	NS	NS	NS	NS	NS
S	NS	NS	0.678	NS	NS
WS	NS	NS	NS	NS	NS

(***Notations:*** W_1 and W_2 are unneutralized and neutralized chhana whey, respectively and S_1, S_2 and S_3 are used for sucrose 45, 50, 55 (% w/w) levels in whey, respectively).

Values are the means of ten semi-trained panelists. Mean having same superscript in columns did not differ significantly by LSD.

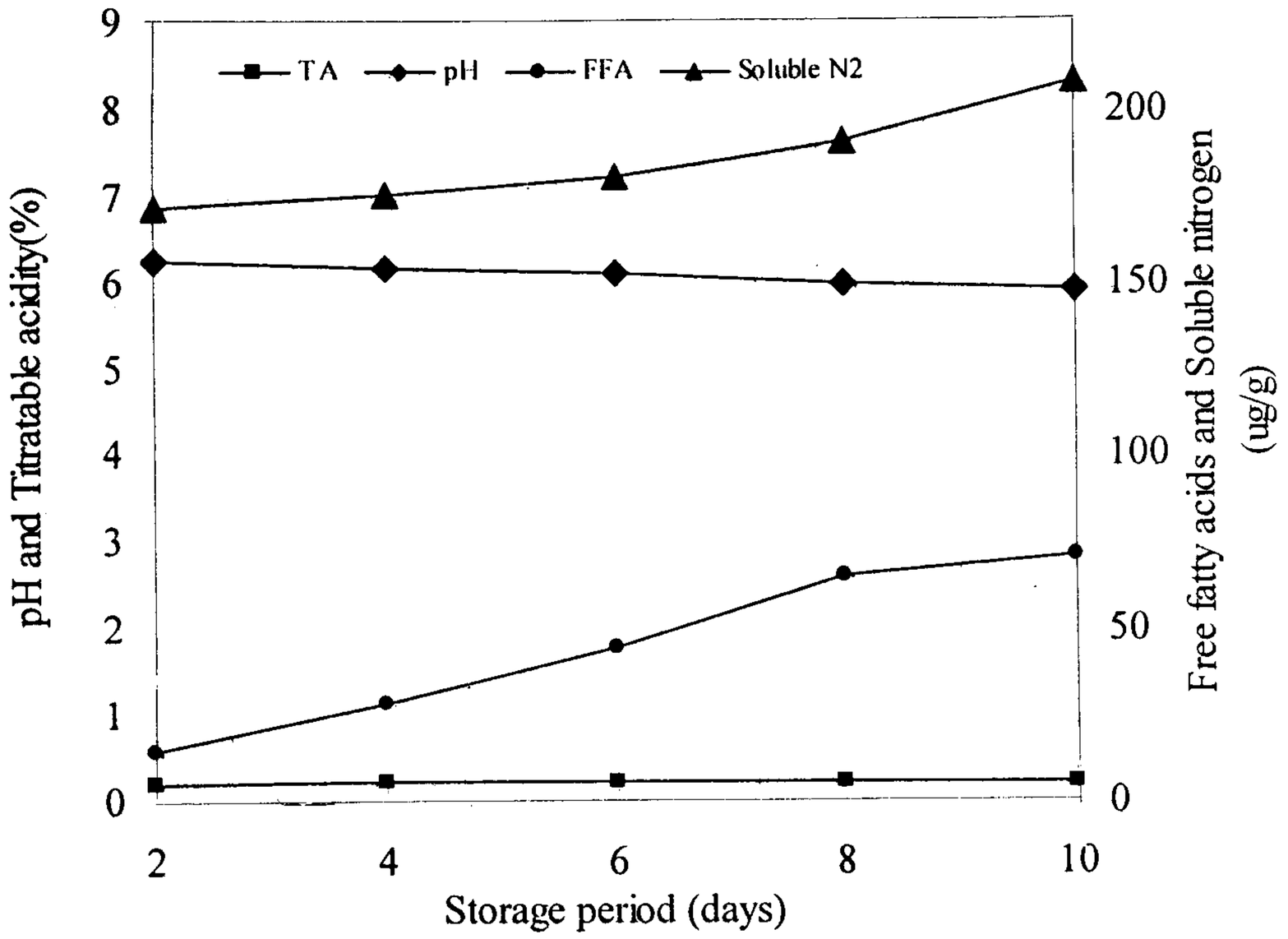

Fig. 1: Effect of storage period (days) on chemical parameters of *rasogolla*

COOKING MEDIUM AND TIME OF *RASOGOLLA* SAMPLES

The whey sucrose syrup had exhibited an excellent foaming ability as compared to that of control syrup. The un-neutralized (0.21 % lactic acid) and neutralized (0.12 % lactic acid) chhana whey syrup medium (55°B) required significantly higher cooking time than control sugar syrup (55°B). But the cooking time had shown to decreased as the final °B of the final cooking medium increased. However, in both the above treatments at 65°B medium had found significantly lower cooking time than control (Table 1). It might be due to higher boiling point of cooking medium due to increase in total soluble solids. It had also increased foaming characteristics of medium which could adhere on the product surface resulting in more swell of chhana balls and facilitates quicker absorption of syrup within the porous structure.

All the whey sugar syrups had exhibited an excellent foaming ability as compared to that of control syrup. The unneutralized (0.21 % lactic acid) and neutralized (0.12 % as lactic acid) chhana whey syrup medium (55°B) was found significantly higher cooking time than control sugar syrup (55°B). The cooking

time was inversely affected to the level of sugar added to the syrup (Table 3). This finding agreed with the result of Bhattacharya & Raj (1980).

The brown color development in repeatedly used syrup had shown problem during cooking of *rasogolla*. The deleted browning of syrup in the former case could be ascribed to the liberation of –SH groups (mainly from β-lactoglobulin) upon heat denaturation and production of acids (lactic acid and forming among others) by degradation of lactose as a result of heating. This in turn may have inhibitory effect on browning (Jennes & Patton, 1969).

CHEMICAL COMPOSITION OF *RASOGOLLA*

The fat, protein and total solid content in the *rasogolla* samples prepared in whey syrup mediums were observed significantly lower values, whereas the sucrose content had significantly higher values than control. This might be due to lack of proper sponginess of the control product, which led to decrease absorption of syrup (Table 2).

CHEMICAL CHANGES IN *RASOGOLLA* DURING STORAGE

The initial acidity was found to be 0.16 %. During the storage periods it was found that the maximum acidity at 30°C was 0.21 %, whereas no significant ($p<0.05$) increase was recorded at lower temperature. The initial pH of *rasogolla* was 5.25 which decreased with increase of storage period (days). The free fatty acids significantly ($p<0.05$) increased with the storage days. It might be due to hydrolysis of milk fat catalyzed by enzyme lipase. Milk contains higher amount of low molecular fats which had more susceptible to enzyme lipase and producing free fatty acids (Joshi, 1994). The soluble nitrogen significantly ($p<0.05$) increase with the storage days (Fig. 1).

SENSORY EVALUATION OF *RASOGOLLA*

In un-neutralized whey medium as the sucrose level increased the color and appearance score was significantly ($p<0.05$) decreased, whereas, neutralized whey medium 50 % (w/w), sucrose gave higher color score than others. In these two treatments the other sensory score was not significantly affected with the increased level of sucrose (Table 4).

The whey system (unneutralized and neutralized) did not differ significantly to the sensory score of paneer, whereas the sugar levels affected the color and appearance of the product but did not significantly affect the other sensory scores (Table 5).

ACKNOWLEDGEMENT

The authors would like to express their sincere gratitude to Prof. Dr. Dilip Subba, Assistant Dean, Central Campus of Technology and S.B. Katuwal, Chairman, Food Technology Instruction Committee, Dharan, for constructive suggestion and cooperation during the period of this study.

WORKS CITED

AOAC (1990).*Official Methods of Analysis*. 15th ed. Arlington: Association of Official Analytical Chemists.

Bhattacharya, D.C. & Raj, D. (1980). *Studies on the Production of Rasogolla,* part I, Traditional method, *Indian J. Dairy Sci., 33,* 137-143.

Date, W.B., Lewis, Y.S; John, D.S. & Bhatia, D.S. (1958). Studies on the Preservation of Rasogolla. *Food Science,* 7, 211-227.

Egan, H., Kirk, R.S. & Sawayer, R. (1981). *Pearson's Chemical Analysis of Foods.* 8th ed., Edinberg: Churchill Livingstone Inc., Robert Stevenson House.

Goel, B.K. & Agrawal, A.K. (1994). Optimization of processing parameters for continuous *rasogolla* manufacturing. *Indian Dairy Man.* 16, 11.

HMG/Nepal (1991). *Ten year dairy development plan, 1990-2000.* 1, Ministry of Agriculture, Final Draft, June.

Jennes, R. & Patton, S. (1969). Milk proteins. *Principle of Dairy Chemistry.* p. 101.

Jul-Overlay, A. (1986). *Chemical & Bacteriological Methods for the Examination of Milk,* 5th ed., Copenhagen, Denmark.

Lawes Agricultural Trust (1995). *Rothamsted Experimental Station, PC/Windows 95,* Genstat 5 Second Edition (for Windows), Library Release 3[3] (PL9).

Mitra, S.N., Ray, S.R., Mathav, T.V. Basaki, A. & Ray, A.K. (1967). Studies on the composition of sweetened *rasogolla.* In: Natarjan, A.M. (2002). *Manufacturing Profile and Problems in the Preparation of Quality* Chhana-based Canned Traditional Sweet–"*rasogolla*", *Indian Dairyman,* 54: 10.

Ranganna, S. (1994). *Handbook of Analysis & Quality Control for Fruits & Vegetable Products.* 2nd ed", New Delhi: Tata McGraw-Hill Publishing Company Limited, p. 607.

HMG/Nepal (2002). *Statistical Pocket Book.* Kathmandu: HMG, National Planning Commission Secretariat, Central Bureau of Statistics, p. 84.

Singh, G.P. & Ray, T.K. (1977). Effect of coagulants on the quality of chhana whey. *J Fd. Sci. Technol.,* 14(5): 205.

Thapa,T.B. (1999). Human resource need for the dairy sub-sector: A National Perspective, A paper presented at the National Food Industry Seminar at Central Campus of Technology, Hattisar, Dharan, on the auspicious occasion of Silver Jubilee Celebration of CCT, 9-10 April.