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Effects of Water Quality on Reeling Performance and Raw Silk Quality of Silkworm (Br-Urboshi) Cocoons: Water of Bholahat Region

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For many years raw silk output of Bholahat area of Nawabganj district has been becoming the highest. At present it is about 70% of Bangladesh's total raw silk production. It would be helpful to know the influence of water on raw silk for existing reeling centres and also while setting up new reeling centres for achieving better results. An attempt has been made in this study to assess the effect of these chemical constituents of available natural water collected from different sources in the traditional silk reeling areas of Bholahat on the reeling performance and quality. Four different water samples of Bholahat region together with distilled water were used to reel silk cocoons of the race (Br-Urboshi) and their effects on raw silk and silk quality were analysed. The results obtained and discussed herein suggest that water from bore-well and river water which contain relatively low hardness (total, temporary and permanent hardness) and low pH values with acceptable limit for silk reeling produced significantly more raw silk and better reelability, renditta, medium size deviation, tenacity and better winding breaks and cohesion.

INTRODUCTION

The processes of unwinding of silk filament from the cocoon and combining it to suitable size of raw silk yarn depend on the interaction of a number of factors, such as raw materials (quality of cocoon), water reeling[1] and cooking process machinery used and skill. Of them, the quality of water used is the most important single vital factor. The quantity and quality of raw silk produced vary greatly with the impurities, chemical constituents and alkalinity/acidity of the water used during the cooking and reeling process[2].

Different sources of water of the same locality vary greatly in their chemical characteristics and thus affect silk reeling and raw silk qualitative and quantitative characteristics. Water samples collected from the same source of the same locality in different seasons are found to vary greatly in their chemical constituents. The present work was undertaken to study the effects of water quality of Bholahat area on raw silk quantity and quality in the winter and rainy seasons.

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EXPERIMENTAL

100 L of water samples were collected from four sources, *viz.*, pond, tube-well, fore-well and river of Bholahat area together with distilled water in both winter and rainy seasons of the year 1993–1994. The water samples were analysed for qualitative characteristics such as pH value, total hardness, permanent hardness, temporary hardness, electrical conductivity and total mineral contents, etc.

10 kg of cocoons of the silkworm (*Bombyx mori* L.) race Urboshi (improved multivoltine) were collected from the cocoon market in both winter and rainy seasons. The cocoons were divided into five groups and were oven dried; cooking was carried out in single pan and were reeled on multiend reeling machine. All the parameters were kept constant. Silk cocoons were stifled by hot air drying method[2] at 85–90°C for 3 h. 100 g of cocoons were reeled separately in each water sample using BSRTI (Rajshahi, Bangladesh) multiend reeling machine. All reagents used were from E. Merck, Darmstadt, Germany.

RESULTS AND DISCUSSION

Water quality: The various characteristics of water (Bholahat area) used for investigating the effects of water quality on reeling efficiency of silk cocoons were studied and the results are shown in Table-1.

TABLE-1
WATER QUALITY VARIATION AT DIFFERENT SOURCES IN BHOLAHAT REGION (WINTER AND RAINY SEASON)

Source of water	pH value	Total hardness ppm	Permanent hardness ppm	Temporary hardness ppm	Specific electrical conductivity ohm^{-1}	Mineral (%)
Pond water	W-8.40	W-100.00	W-80.20	W-50.00	W-37.7×10^{-5}	W-0.02
	R-8.05	R-125.00	R-75.00	R-50.20	R-26.2×10^{-5}	R-0.03
Tube-well	W-8.20	W-270.00	W-184.40	W-86.01	W-42.1×10^{-5}	W-0.04
	R-7.85	R-240.00	R-180.20	R-64.00	R-40.3×10^{-5}	R-0.05
Bore-well	W-7.70	W-99.00	W-72.60	W-27.00	W-15.6×10^{-5}	W-0.02
	R-7.50	R-97.00	R-75.60	R-22.00	R-13.5×10^{-5}	R-0.025
River water	W-7.80	W-100.00	W-74.61	W-25.30	W-16.0×10^{-5}	W-0.03
	R-7.50	R-99.00	R-74.00	R-25.00	R-40.1×10^{-5}	R-0.03
Distilled water	6.70	0.00	0.00	0.00	0.00	0.00
CD at 5%	W-0.28	W-32.98	W-22.38	W-32.99	—	—
	R-0.22	R-28.96	R-21.77	R-8.59	—	—
CD at 1%	W-0.76	W-89.25	W-60.57	W-89.30	—	—
	R-0.59	R-78.36	R-58.92	R-23.25	—	—

The data presented in Table-1 suggest that the pH values of winter season recorded in pond, tube-well, bore-well, river and distilled water are 8.40, 8.20, 7.70, 7.80 and 6.70 respectively. pH value of rainy season recorded in pond, tube-well, bore-well, river and distilled water are 8.05, 7.85, 7.50, 7.50 and 6.70 respectively. The pond and tube-well water contain higher pH and distilled water contains lower one. The values of pH of bore-well and river water, although slightly alkaline, are within the acceptable limit for silk reeling.

The total, permanent and temporary hardness of pond, tube-well, bore-well, river and distilled water of winter season are found to be (130.00 ppm, 80.20 ppm, 50.00 ppm), (270.00 ppm, 184.40 ppm, 86.01 ppm), (99.00 ppm, 72.60 ppm, 27.00 ppm), (100 ppm, 74.61 ppm, 25.30 ppm) and (0.00 ppm, 0.00 ppm, 0.00 ppm) respectively. The total, permanent and temporary hardness of pond, tube-well, bore-well, river and distilled water of rainy season are found to be (25.00 ppm, 75.00 ppm, 50.20 ppm), (240.00 ppm, 180.20 ppm, 64.00 ppm), (97.00 ppm, 75.60 ppm, 22.00 ppm), (99.00 ppm, 74.00 ppm, 25.00 ppm) and (0.00 pm, 0.00 ppm, 0.00 ppm) respectively. Tube-well water contains higher, total, permanent and temporary hardness and bore-well and river water contain lower hardness than tube-well and pond water. Table-1 also shows that the electrical conductivity of tube-well water is the maximum. But tube-well water is not good for reeling purposes when its mineral contents are considered. So, bore-well and river water again look to be acceptable for reeling purposes[3,4].

Distilled water is also not quite suitable on account of the appreciable releases of acidic substances by the cocoons during cooking and reeling operations. Therefore, slightly alkaline water has a good solvent effect on dried and hard sericin of the cocoons[3].

Reeling efficiency: We observe from Table-2 that renditta in winter and rainy season of pond, tube-well, bore-well, river and distilled water using BR-Urboshi race are (13.79, 12.50), (17.09, 16.67), (10.81, 10.53), (11.17, 11.24) and (13.68, 0.00) respectively. It is seen that the renditta using bore-well water is minimum (10.81, 10.53) and that using river water (11.17, 11.24) is nearer to it. The value of

TABLE-2
ANALYSIS OF COMPARATIVE REELING PERFORMANCE AND RAW SILK QUALITY

Source of water	Renditta	Raw silk (%)	Winding breaks/h/ hanks	Penier	Size deviation	Tenacity g/denier	Cohesion	Reelability (%)
Pond	W-13.79	W-7.25	W-1.00	W-22.10	W-2.86	W-3.30	W-40	W-50.00
	R-12,50	R-8.00	R-1.00	R-20.00	R-2.65	R-3.30	R-40	R-52.00
Tube-well	W-17.09	W-5.85	W-1.55	W-22.75	W-2.89	W-3.00	W-35	W-49.00
	R-16.67	R-6.00	R-1.50	R-22.70	R-2.89	R-3.01	R-40	R-51.50
Bore-well	W-10.81	W-9.25	W-0.00	W-20.25	W-2.42	W-3.40	W-45	W-53.60
	R-10.53	R-9.50	R-0.00	R-20.25	R-2.40	R-3.50	R-45	R-55.61
River	W-11.17	W-8.95	W-0.00	W-22.50	W-2.44	W-3.40	W-45	W-52.50
	R-11.24	R-8.95	R-0.00	R-21.50	R-2.43	R-3.45	R-40	R-53.49
Distilled water	R-13.68	R-7.31	R-0.00	R-20.85	R-1.90	R-3.75	R-40	R-50.73
CD at 5%	W-2.12	W-0.75	W-0.24	W-0.71	W-0.41	W-0.81	W-1.85	W-1.07
	R-1.48	R-0.62	R-0.24	R-0.59	R-0.41	R-0.93	R-1.39	R-1.33
CD at 1%	W-5.74	W-2.03	W-0.67	W-1.93	W-1.11	W-2.22	W-5.02	W-2.89
	R-4.01	R-1.68	R-0.67	R-1.59	R-1.11	W-2.54	R-4.26	R-3.60

renditta of tube-well water is maximum (17.09, 16.67). It may be observed that when pH is high renditta is high due to high loss of sericin or gum and increases wastages.

The raw silk percentages obtained by using pond, tube-well, bore-well, river and distilled water (winter and rainy season) are (7.25, 8.00), (5.85, 6.00), (9.25, 9.50), (8.95, 8.95) and (7.31) respectively. It is seen that the raw silk percentage using bore-well water is maximum (9.25, 9.50) and tube-well water is minimum (5.85, 6.00). The poor raw silk percentage is due to alkaline pH, high and low hardness present in water.

The winding breaks in pond, tube-well, bore-well, river and distilled water (winter and rainy season) are found to be (1.00, 1.00), (1.55, 1.50), (0.00, 0.00), (0.00, 0.00) and (0.00, 0.00) hak/h respectively. The maximum winding break is recorded in tube-well water (1.55, 1.50).

The denier in pond, tube-well, bore-well, river and distilled water (winter and rainy season) are recorded to be (22.70, 20.00), (22.75, 22.70), (20.25, 20.25), (22.50, 21.50) and 20.85 respectively. These findings are in good agreement with the literature values[5].

The size deviation in pond, tube-well, bore-well, river and distilled water (winter and rainy season) are found to be (2.86, 2.65), (2.89, 2.89), (2.42, 2.40), (2.44, 2.45) and 1.90 respectively. It may be seen that the size deviation is minimum in distilled water. This is probably because of very low hardness.

It may be observed that the values of tenacity are very near to each other. This shows that the differences in parameters of different sources of water have no influence on tenacity.

The cohesion in pond, tube-well, bore-well, river and distilled water (winter and rainy season) are found to be (40, 40), (35, 40), (45, 45), (45, 40) and 40 respectively. Considering cohesion the bore-well water looks to be the better one for reeling purposes.

The reelability percentages recorded in pond, tube-well, bore-well, river and distilled water (winter and rainy season) are (50.00, 52.00), (49.00, 51.50), (52.60, 55.61), (52.50, 53.49) and 50.73 respectively using Br-Urboshi race. Reelability percentages of (53.60, 55.61) in bore-well water and that of (52.50, 53.49) in river water were significantly higher than those of pond, tube-well and distilled water.

From the above it is seen that the data recorded in rainy season are better ones than those of winter season. Most probably the reason lies in the fact that the very soft rain water mixes with the various sources of water thereby making them medium soft. This medium soft water (from different sources) gave better results so far as the reeling properties are concerned. But the differences of the data obtained during the winter and rainy seasons are so small that these do not make any difference in the reeling properties.

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