Effect of Different Heat Treatments to Eliminate Added H_2O_2 in Raw Milk*

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ABSTRACT

Composite milk samples from Jersey cows and local buffaloes were studied to know the effect of various heat treatments to eliminate added hydrogen peroxide in raw milk. The composite milk samples were treated with 200, 600, 1000μg/ml H_2O_2 within 30 to 40 minutes after milking and were stored at room temperature. The samples were then heat treated (i) pasteurized at 63°C for 30 min. (ii) heated at 71°C for a moment and (iii) boiled. After an interval of 4 and 8 hrs. samples were analysed for their residual H_2O_2 content by the method given by Amin and Olson (1967). The residual H_2O_2 content in all samples was lowered by heat treatments and this reduction was directly proportional to the heat treatments given to milk. Pasteurization at 63°C for 30 minutes and heating upto 71°C for a moment were equally effective in reducing residual H_2O_2 though the maximum reduction was obtained by boiling. The destruction of H_2O_2 was more in the fair quality buffalo milk than in the fair quality cow milk. However, there was no difference between the good quality cow or buffalo milk. The heat treatment could effectively reduce the residual H_2O_2 content from the milk samples containing lower concentration of added H_2O_2 i.e., 200 and 600 μg/ml. However, at higher concentration i.e., 1000 μg/ml H_2O_2, the reduction was less pronounced.

It was observed that the boiling of the fair quality cow or buffalo milk containing 200 μ g/ml H_2O_2 after 8 hours could completely eliminate H_2O_2 from milk. Since boiling of milk is a common practice in India, the use of H_2O_2 at the concentration of 200 to 300 μ g/ml to increase the shelf life of milk can be suggested.

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INTRODUCTION

THE collection and transportation of fluid milk under the tropical conditions prevailing in India present many difficult problems due to scattered milk production in rural area where there is neither the facilities for chilling nor there is rapid means of transportation. The use of H_2O_2 as a preservative for milk has, therefore, been advocated and tried by some investigators. The quantity of H_2O_2 to be added will depend upon the climate, the quality of milk and period of preservation desired. Different quantities (% by weight) were recommended by various workers: 0·03% (Nambudripad, Laxminarayan and Iya, 1952); 0·04%—0·08% (Aijaz-ul-Haq and Majeed 1966 and Siegenthaler 1967); 0·02%—0·1% (Khan and Vyas, 1971). However, it was found necessary to destroy the residual H_2O_2 from milk which is meant for human consumption as the undecomposed H_2O_2 may cause toxic effect on

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human beings and may create troubles in the manufacture of various milk products. Addition of catalase or catalase containing materials to remove the residual H_2O_2 has been tried by various workers. Besides catalase, use of heat treatment to eliminate the residual H_2O_2 has also been suggested by some workers: Nambudripad *et al.*, 1952. Commonly in India, the milk is boiled before its use, hence the effect of heat on the destruction of the residual H_2O_2 was studied.

MATERIALS AND METHODS

Jersey cow milk and local buffalo milk samples (4 litres each) were collected immediately after milking in the aluminium can. Acidity of fresh milk was recorded and bacteriological quality was determined by Methylene Blue Reduction Test (MBRT).

All the samples were processed in the laboratory within 30 to 40 minutes after milking. Each composite sample (1300 ml each) was divided into three portions and treated with 130 vol H_2O_2 to give final concentration of 200, 600 and 100 µg/ml. All the samples were stored in glass beakers and kept in the laboratory at an ordinary room temperature. During the course of this investigation the room temperature varied between 85°F and 104°F. The three lots of milk containing 200, 600 and 1000 µg/ml H_2O_2 were then heat processed after an interval of 4 and 8 hours. At every interval, each of these three lots were further divided into four lots which then were treated in the conical flasks according to following treatments:

T_0 — Control (Without any heat treatment).

T_1 — Laboratory Pasteurization (63°C for 30 min).

T_2 — Milk heated to 71°C for a moment.

T_3 — Milk boiled.

These milk lots i.e., T_0, T_1, T_2, and and T_3 of each concentration were then analysed for their residual H_2O_2 content at regular intervals as follows:

(A) The acidity and the MBRT were carried out according to "Standard Methods for the Examination of Dairy Products" (1960).

(B) *Estimation of residual H_2O_2:* The residual H_2O_2 was determined from the treated samples by Amin and Olson (1967) method, using titanium sulphate reagent.

RESULTS AND DISCUSSION

The acidity of fresh cow milk samples varied from 0·150% to 0·170% with an average of 0·156%, while the acidity of the fresh buffalo milk samples varied from 0·170% to 0·180% with an average of 0·172%. There was no appreciable increase in acidity of cow and buffalo milk after 4 and 8 hrs from their average initial acidity (i.e., 0·156% in cow milk and 0·172% in buffalo milk) in samples treated with various concentrations of H_2O_2. The results are in agreement with that obtained by Khan and Vyas (1971).

Data in Table 1 indicate that the residual H_2O_2 content in all samples was lowered by heat treatments and reduction in residual H_2O_2 was directly proportional

TABLE 1

The residual H_2O_2 in cow and buffalo milk after heat treatments.

Species	*Quality of milk*	*Time interval hrs.*	*Concentration of H_2O_2 µg/ml*	µg/ml T_0 *Control*	T_1 *Pasteurised*	T_2 *Heated to 71°C*	T_3 *Boiled*
Cow	Good	4	200	22·5	13·8	13·0	6·4
			600	79·4	48·0	48·4	35·4
			1000	139·0	121·8	117·4	104·0
	M.B.R.T. more than 6 hours	8	200	13·8	7·8	7·4	1·2
		8	600	38·6	28·0	28·2	16·0
			1000	112·0	102·4	100·0	90·6
	Fair	4	200	16·8	9·2	9·0	3·8
			600	32·6	23·0	22·6	13·2
			1000	79·2	70·0	67·6	59·6
	M.B.R.T. less than 6 hours.	8	200	9·8	5·8	5·4	0·0
			600	18·4	14·6	14·4	4·6
			1000	65·6	59·4	58·2	49·8
Buffalo	Good	4	200	25·4	13·2	11·14	5·8
			600	64·4	44·6	43·8	31·2
			1000	139·8	121·0	118·4	107·8
	M.B.R.T. more than 6 hours.	8	200	15·2	7·8	7·0	0·8
			600	36·6	25·8	25·0	16·4
			1000	97·6	85·4	84·4	75·0
	Fair	4	200	13·0	8·4	8·0	2·8
			600	22·8	17·6	16·8	9·8
			1000	80·4	68·6	66·8	56·8
	M.B.R.T. less than 6 hours.	8	200	9·2	5·4	4·6	0·0
			600	13·8	10·2	9·2	3·6
			1000	61·0	47·8	42·6	33·4

to the heat treatments given to milk. The destruction of H_2O_2 was more in fair quality cow and buffalo milk containing 200 µg/ml H_2O_2 the boiling could eliminate H_2O_2 completely after 8 hrs of storage at room temperature.

Residual H_2O_2 in cow and buffalo milk of good and fair quality:

Data in Table 2 indicate no difference between the residual H_2O_2 content in good quality cow and buffalo milk; however, the residual H_2O_2 content in fair quality cow milk was higher than in fair quality buffalo milk. The residual H_2O_2 values for good quality cow and buffalo milk were significantly higher than in fair quality cow and buffalo milk.

TABLE 2

Residual H_2O_2 in cow and buffalo milk of good and fair quality. (Average values of all concentrations, treatments and time intervals given in Table 1).

Quality	*Cow*	*Buffalo*
Good	33·42 µg/ml	31·66 µg/ml
Fair	18·66 µg/ml	15·17 µg/ml

TABLE 3

Residual H_2O_2 content after heat treatments to good and fair quality cow and buffalo milk.

Heat treatment	*Cow milk (μg/ml)*		*Buffalo milk (μg/ml)*	
	Good Quality	*Fair Quality*	*Good Quality*	*Fair Quality*
T_0	49·12	28·55	48·14	24·48
T_1	35·91	21·21	33·32	18·08
T_2	34·99	20·55	33·73	16·63
T_3	20·17	9·73	18·58	7·17

Residual H_2O_2 content after heat treatments to good and fair quality cow and buffalo milk:

At every heat treatment, the residual H_2O_2 content in good quality cow and buffalo milk was higher than in fair quality milk as shown in Table 3. Similarly, there was significant difference between the various heat treatments. The average residual H_2O_2 content was highest in T_0 (Raw) and lowest in T_3 (Boiled). There was no difference between the residual H_2O_2 content in T_1 (Pasteurized) and T_2 (Heated to 71°C) samples of milk.

This indicates that due to heat treatment, there was significant reduction in residual H_2O_2 content from good and fair quality cow and buffalo milk. The

TABLE 4

Residual H_2O_2 in good and fair quality cow and buffalo milk containing different concentration of H_2O_2.

Concentration of H_2O_2 μg/ml	*Cow milk (μg/ml)*		*Buffalo milk (μg/ml)*	
	Good Quality	*Fair Quality*	*Good Quality*	*Fair Quality*
200	9·39	6·61	9·41	5·78
600	36·29	16·21	33·15	11·37
1000	109·50	60·64	101·70	53·04

TABLE 5

Residual H_2O_2 after 4 hours and 8 hours interval and various heat treatments from the cow and buffalo milk containing 200, 600 and 1000 μg/ml H_2O_2 (Average values of all concentrations, treatments).

	Concentration of H_2O_2 μg/ml	*Cow milk (μg/ml)*		*Buffalo milk (μg/ml)*	
		4 hrs.	*8 hrs.*	*4 hrs.*	*8 hrs.*
T_0	200	20·01	12·36	19·11	12·49
	600	48·60	25·59	38·31	22·58
	1000	103·37	83·64	104·10	68·89
T_1	200	12·15	7·64	11·50	7·40
	600	33·86	20·32	27·58	16·57
	1000	91·47	75·71	89·19	62·95
T_2	200	11·70	7·19	10·88	6·60
	600	33·95	19·99	40·03	15·47
	1000	88·14	73·87	86·86	58·87
T_3	200	5·86	1·31	4·87	1·231
	600	21·27	9·34	16·61	6·401
	1000	76·52	64·91	75·70	49·29

T_1 and T_2 treatments were equally effective in reduction of H_2O_2 whereas the T_3 treatment was most effective.

Residual H_2O_2 in good and fair quality cow and buffalo milk containing 0·02, 0·06, 0·10% H_2O_2:

It can be seen from Table 4, that the three concentrations i.e. 200, 600, 1000 μg/ml H_2O_2 added to good quality and fair quality cow as well as buffalo milk differed significantly in their residual H_2O_2 content.

At all concentrations and treatments the destruction of H_2O_2 was higher after 8 hours than after 4 hours interval in cow as well as in buffalo milk as shown in Table 5. In the milks containing 200 μg/ml and 600 μg/ml H_2O_2 there was definite reduction in residual H_2O_2 values at pasteurization, heating at 71°C and boiling temperatures after 4 hours and 8 hours intervals. However, the maximum reduction was obtained by boiling. But at the concentration of 1000 μg/ml, the destruction of H_2O_2 was less pronounced at all treatments.

REFERENCES

Aijaz-ul-Haq and M. A. Majeed, 1966. Physical changes in buffalo milk preserved with H_2O_2. *Pak. Jour. Agri. Sci.*, **3**: 113 (C.F.:—*Dai. Sci. Abst.*, 1966, **30**, 3, 170:1062).

APHA, 1960. Standard Methods for the Examination of Dairy Products. American Public Health Association, Inc. Eleventh Edition.

Amin, V. M. and N. F. Olson, 1967 Quantitative determination of H_2O_2 in milk. *J. Dai. Sci.*, **50** (4): 713.

Khan, A. O. and S. H. Vyas, 1971. Use of H_2O_2 in enhancing the keeping quality of Market milk. *Allahabad Farmer*, **45** (6): 543-548.

Nambudripad, V.K.N., H. Laxminaryana and K.K. Iya, 1952. Bactericidal efficiency of H_2O_2. (III use of H_2O_2 for preservation of milk). *Indian J. Dairy Sci.* **5** (3): 135-46.

Ranganathan, B., V.K.N. Nambudripad, A. T. Dudani and K.K. Iya, 1964. Bacterial flora of milk & Milkproducts in India. ICAR Research Series No. 37.

Siegenthaler, E. J. 1967. Possibilities and limits for the use of hydrogen peroxide to facilitate milk collection under tropical countries. *Milchwissenschaft*, **22** (1): 12-15.