   Indian Pediat. 17, 7^9, 1980.

2. L-Fucose content of milk from Bengalee Mothers. 

3. Lipolytic Activities in milk of Bengalee Mothers. 
   (In preparation).

4. Ampicillin Residues in milk of lactating mothers. 
   (In preparation).

5. Sulphamethoxazole Residues in milk of lactating mothers. 
   (In preparation).

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ALKALINE PHOSPHATASE ACTIVITY IN HUMAN TRANSITIONAL MILK

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A.B. Banerjee†

ABSTRACTS

The activity of alkaline phosphatase in transitional milk from 55 Bengalee mothers was assayed. Optimum pH for alkaline phosphatase activity in both human and cow milk was found to lie between 9.8 and 10.0 with phenylphosphate as substrate. Human milk alkaline phosphatase was found more thermostable than alkaline phosphatase of bovine milk and a possible occurrence of an isoenzyme, heat-stable alkaline-phosphatase was also indicated. By heating at 75°C for 15 min., bovine milk lost activity of this enzyme completely, but human milk showed a residual activity (5-12 per cent of the original) under these conditions. Average alkaline phosphatase activity of transitional milk from normal Bengalee mothers was found to be 4.74 with a S.D. of 1.96 K.A.U. Out of 55 samples tested, 70 per cent showed activity range of 3.0-6.5 K.A.U.

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Introduction

Among the proteins of milk, besides casein, globulin and albumin, are included numerous milk enzymes. The distribution pattern of enzymes is quite different in milks of different species and in different stages of lactation of an individual species. Phosphatases which are concerned with calcification of bone and other important reactions of body processes are also found to be present in milk.

As in other body fluids, the enzyme activities in milk may be influenced by different factors, including genetic make up (ethnic groups), nutritional status and pathological conditions of the donors.

Belavady tried to correlate the activities of alkaline phosphatase and xanthine oxidase in the breast milk of poor Indian women with the protein, riboflavin, thiamine, etc. nutrients of the milk.

In the present paper, some other aspects of alkaline phosphatase (orthophosphoric monoesterase, phosphohydrolase E.C. 3.1.3.1) in milk—the pH optimum for its activity, the thermal inactivation pattern of the enzyme and normal average value of transitional milk alkaline phosphatase from Bengalee mothers have been reported.

Material and Methods

Our studies were restricted to mothers of Bengalee community of middle and low income groups. The average age of the mothers was 26-9 with a S.D. of 6-54 years. They were all non-vegetarian by dietary habit.

Collection of milk: Human milk samples were collected from mothers of Baker Ward, Nilratan Sarkar Medical Hospital, Calcutta. The mothers were grouped according to the mode of delivery, i.e. (i) normal delivery (waiting for ligation),
Results and Discussion

The determination of enzyme concentration in body fluids has become an indispensable diagnostic method in many illnesses. The body fluid most extensively studied for this purpose is blood. A large amount of body fluid is formed and secreted in the form of milk during lactation. Fresh milk contains different enzyme activities. Most of these enzymes are incorporated into milk from body cells during milk formation and activities of these enzymes may be dependant on health and nutritional status of the mothers.

I. pH optimum and heat stability of alkaline phosphatase: The optimum pH for the activity of human milk alkaline phosphatase was 9-8-10-0 in carbonate/bicarbonate buffer (Graph 1). The pH activity profile of human milk is almost the same as that of cow milk.

Average activity of the enzyme: For the determination of average value of human milk alkaline phosphatase 55 samples were studied under three major groups: (i) normal delivery—30 samples, (ii) forcep delivery—5 samples and (iii) Caesarian delivery—20 samples.
same as that of cow's milk assayed under identical conditions (Graph 1). The phosphatase activity recorded below pH 7 (Graph 1) is definitely not due to alkaline phosphatase. Phenyl phosphate was hydrolysed though at very slow rate even at pH 5-0 may be due to activity of hereto uncharacterised enzyme in the milk which had reactivity like that of acid phosphatase. But this proposition has yet to be confirmed.

Heat stability of human milk alkaline phosphatase is comparatively greater than that of cow's milk. The phosphatases of cow milk are inactivated within the temperature range 70°C-75°C, and made the basis of tests for adequate pasteurization, but we found that human milk retains 5-12 per cent of original alkaline phosphatase activity even after heating at 75°C for 15 min. (Table I, Graph 2). However, within temperature range of 30°C to 55°C, alkaline phosphatase of human milk is inactivated comparatively more than that of cow milk. At temperature range of 55°C-75°C, the situation is reversed (Graph 2). It is interesting to note that the presence of such heat stable alkaline phosphatase (resistance to heating at 56°C for 30 min.) was reported earlier in normal human placenta and serum of pregnant woman. This indicates the possibility of the presence of a heat-stable alkaline phosphatase, isoenzyme both in serum and milk during pregnancy and lactation. However, confirmation of such proposition needs further studies.

**Table I**—Showing effect of heat treatment of alkaline phosphatase activity (in K.A.U.)

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>28°C*</th>
<th>45°C</th>
<th>55°C</th>
<th>65°C</th>
<th>75°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5:8</td>
<td>3:0</td>
<td>2:0</td>
<td>1:8</td>
<td>0:5</td>
</tr>
<tr>
<td>2</td>
<td>5:1</td>
<td>3:4</td>
<td>2:4</td>
<td>1:5</td>
<td>0:8</td>
</tr>
<tr>
<td>3</td>
<td>4:8</td>
<td>9:4</td>
<td>7:8</td>
<td>3:0</td>
<td>0:8</td>
</tr>
<tr>
<td>4</td>
<td>4:6</td>
<td>2:8</td>
<td>2:2</td>
<td>1:2</td>
<td>0:25</td>
</tr>
<tr>
<td>5</td>
<td>17:5</td>
<td>11:9</td>
<td>7:1</td>
<td>3:5</td>
<td>1:8</td>
</tr>
<tr>
<td>6</td>
<td>3:5</td>
<td>2:4</td>
<td>1:5</td>
<td>1:1</td>
<td>0:5</td>
</tr>
</tbody>
</table>

*Room temperature

II. The range of activity and average value of transitional milk alkaline phosphatase: The activity of alkaline phosphatase in transitional milk of 48 normal Bangalore mothers ranges from 3:0 to 10:9 K.A.U. (Table II). This range is very similar to that one reported by Kon and Mawson. Stewart et al. and Belavady too reported a wide range of milk alkaline phosphatase activity in first month of
TABLE II—Showing range and average value of transitional milk alkaline phosphatase activity of Bengalee mothers

<table>
<thead>
<tr>
<th>Mode of delivery</th>
<th>No. of samples*</th>
<th>Range of alkaline phosphatase activity in K.A.U.*</th>
<th>Average value of milk alkaline phosphatase activity in K.A.U.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Normal</td>
<td>25</td>
<td>3-0-10-0</td>
<td></td>
</tr>
<tr>
<td>2. Forcep</td>
<td>5</td>
<td>4-8-9-6</td>
<td>4-74±1-96 (S.D.)</td>
</tr>
<tr>
<td>3. Lower uterine caesarian section</td>
<td>18</td>
<td>3-6-10-0</td>
<td></td>
</tr>
</tbody>
</table>

* No. of samples and ranges of milk alkaline phosphatase activity are mentioned excluding extreme results, i.e. 5 samples of group 1 and 2 samples of group 3 are excluded.

lactation. In the present study, a total of 55 samples were tested under three major groups according to the mode of delivery—normal, forcep and Caesarian section. But it was found that mode of delivery had no significant influence on the activity of the enzyme in milk, whereas presence of some disease affected the activity markedly, i.e., a mother who had an ischemic heart showed an activity of milk alkaline phosphatase 17-5 K.A.U. (normal delivery), a mother who had a partial gastrectomy before 0-8 K.A.U. (normal delivery). However, at present we cannot comment on the association of increased or decreased milk enzyme activity with any particular disease as the number of such samples tested is too small.

Excluding extreme values, average alkaline phosphatase activity of transitional milk from 48 apparently normal Bengalee mothers came to 4-74 K.A.U. with a S.D. of 1-96 (Table II). About 70 per cent of the samples tested contained the enzyme activity in the range of 3-0-6-5 K.A.U.

REFERENCES