

EFFECT OF CALCITONIN HORMONE ON THE CALCIUM LEVEL IN GOAT LENS—*IN VITRO* STUDIES

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ABSTRACT

Investigations conducted with goat lenses incubated in Ringers solution in the presence of calcitonin hormone indicate that calcitonin produced significant increase in lens calcium level. These results provide a new approach to an understanding of calcium metabolism of lens and its consequent implications in the development of cataract induced by hypocalcemia.

INTRODUCTION

CALCIUM plays diverse roles in living organisms. Besides being a major component of the skeleton, calcium has vital functions in body fluids and soft tissues¹. Calcium has recently emerged as a pivotal agent in the regulation of lens transparency. Calcium metabolism has been associated with visual disturbances especially in crystalline lens². Calcium level in the lens is moderately low initially, but an influx of calcium into the lens initiates biochemical events eventually leading to the formation of cataracts. The implication of calcium in cataract formation has been correlated with the consistent findings that its level is increased during aging and in senile cataract formation^{3,4}.

Lenticular calcium homeostasis has been a subject of considerable interest because sodium and potassium imbalances in human cortical cataract is often accompanied by pronounced elevation of lens calcium level⁵. Lens can accumulate calcium levels far in excess of those present in the surrounding fluid environment⁶.

METHODS

Forty fresh goat eyes were collected from butcher shop and transported to the laboratory by keeping in an ice-box. Lenses from the eyes were dissected and weighed. The wet weight of the lenses ranged between 0.7 and 0.8 g. These lenses were divided in two groups (I & II). Group I of 20 lenses (control) was incubated separately, each in 5 ml Ringer solution (NaCl 111 mM; MgCl₂ 2 mM; KCl 5 mM; glucose 5 mM; NaHCO₃ 25 mM; CaCl₂ 2 mM) and 0.1 ml solution containing NaCl (0.6%) with gelatine (0.1%) which served as vehicle for calcitonin. Group II of 20 lenses (experimental) each of which was also incubated separately in the same volume of Ringers solution with 0.1 ml solution containing

5 MRC (Medical Research Council) of porcine calcitonin (Armour Pharmaceutical Company Ltd., USA, Lot No. K 974-068) dissolved in aqueous 0.6% NaCl and gelatine (0.1%). After incubation for 0, 4, 8 and 12 h, five lenses from each control and experimental groups were removed and rolled on a filter paper wet with EGTA (1 mM) to remove calcium adhering to the lens. Lenses were then homogenized in 2 ml phosphate buffer (0.1 M, pH 7.4) and an equal volume of trichloroacetic acid (10%) was added to precipitate the protein. Calcium was determined from the supernatant (after centrifugation at 5000 rpm for 10 min) by the atomic absorption method.

The results reported are the mean \pm standard error of the mean. Because of the variability in animals, lenses in all cases were paired for statistical analysis which was done using Student's *t* test⁷ for paired data. A confidence level of 95% or greater was considered to be significant.

RESULTS AND DISCUSSION

Figures 1 and 2 show that there is no apparent difference in the levels of calcium in unincubated lenses of control and experimental groups. However, after incubation, the level of calcium increased in lenses of the experimental group by 32%, 53% and 110% in 4, 8 and 12 h respectively. The results suggest that the increase in the lens calcium level is dependent upon the incubation time. Calcitonin thus evoked progressive hypercalcemia in goat lens.

The present results show that calcium level in the lens is maintained when cultured in a medium. However fortification of the culture medium with calcitonin induces a significant increase in calcium level in the lens after 4, 8, 12 h incubation periods. This is probably achieved by a chemical signal (calcitonin) mediated by a specific membrane recep-

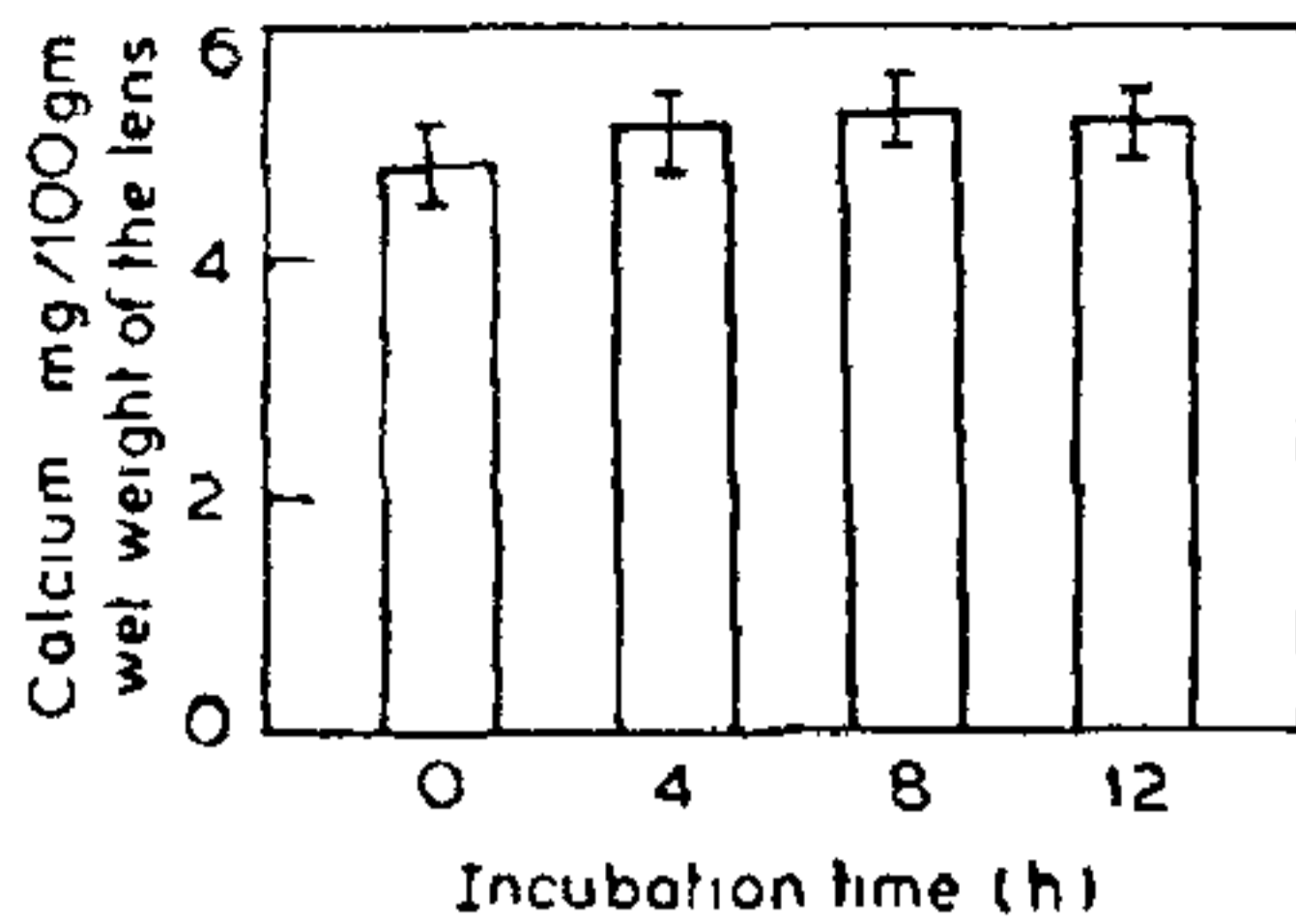


Figure 1. Control.

tor present on cell lens membranes which allow an influx of Ca^{2+} inside the lens. This observation is similar to that made by Baldwin and Bentley⁸ who reported that calcium content of the lens is maintained at a constant level due to the activity of a 'Ca pump'. They have further shown that if the energy metabolism is compromised, additional calcium gets accumulated.

The results thus show that calcitonin induces hypercalcemia in goat lens. Earlier studies have shown that vitamin D_2 induced hypercalcemia in rat lens⁹ while *in vitro* studies with goat lens showed opposite effect¹⁰. The mechanism by which lens calcium increased in the presence of calcitonin in the

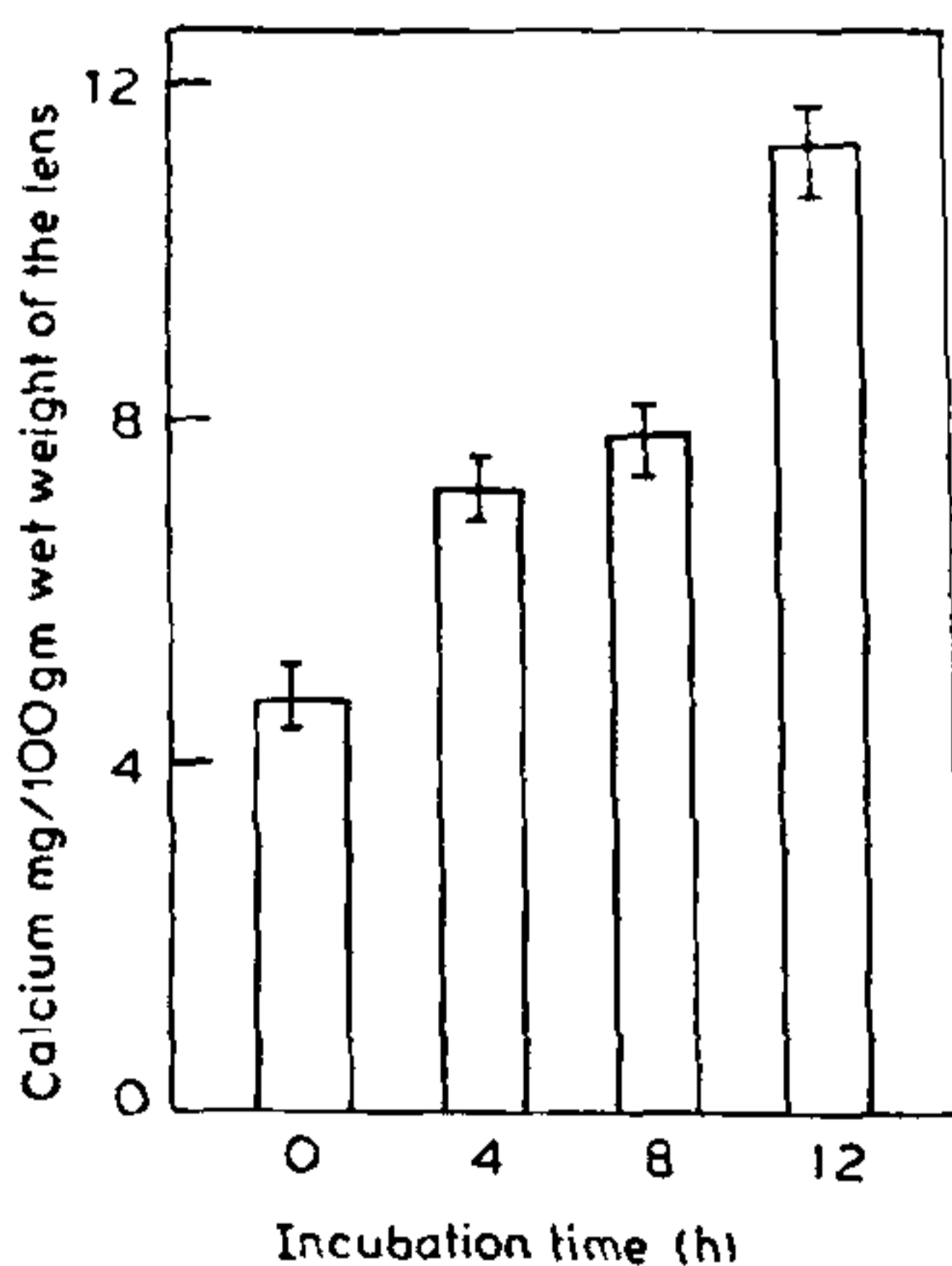


Figure 2. Experimental.

culture medium is unknown. However, the present finding suggests the possibility of existence of specific receptors of calcitonin on lens membrane cells. Such specific receptors of calcitonin have earlier been identified to be present in kidney¹¹, bone¹², human lymphocyte and human bone¹³.

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