

CHAPTER - IVSEASONAL ALTERATIONS IN THE ASCORBIC ACID CONTENT
OF LIVER, MUSCLE AND GONAD IN NORMAL AND
PINEALECTOMISED DOMESTIC PIGEONS, COLUMBA LIVIA

Of the various vitamins, ascorbic acid (AA) has assumed greater significance due to its multiple involvement in tissue structure and function. Due to its high redox potential, one of the earliest functions ascribed to it was that of participation in oxido-reduction processes in tissues (Meiklejohn, 1953), a function which in recent years is being increasingly accepted for many tissues and in many situations (Mapson, 1953; Goodwin, 1960; Ramachandran et al., 1975; Asnani et al., 1976). Processes like haematopoiesis, immunity, metabolism of mucopolysaccharides, connective tissue formation and enzyme stabilization are all purported to be dependent on AA. Rusch and Kline (1941), Levine et al. (1941), Banerjee and Ghosh (1947), Mazur et al. (1961) and Banerjee and Ganguli (1962) have all suggested involvement of AA in various metabolic activities as its deficiency leads to disturbances in carbohydrate, lipid, protein and iron metabolism. Metabolic processes and reproductive activities are also reported to bring about variations in AA content of tissues in insects, birds and mammals (Chinoy, 1969; 1970; 1972a; Chinoy et al., 1973). Yet another role ascribed to AA is its participation in steroidogenesis (Szent Gyorgii, 1957; Bacq and Alexander, 1961; Biswas and Deb, 1970; Chinoy, 1972a & b; Chinoy et al., 1978).

Though the availability of glucose and a number of other factors exert regulatory influence on the synthesis and availability of AA, metabolically active tissues and steroidogenic sites generally tend to show fluctuations in its total content according to functional status. Gonads and adrenals, the major steroidogenic centres in vertebrates usually have higher stores of AA and its depletion during active phase of the tissues are documented. Since the gonadal activation and regression in seasonal breeders are known^{to} bring about alterations in AA content and as pineal-gonad axis has assumed a definite reality, assessment of tissue AA contents in relation to pineal functioning is worthwhile. Hence in the present study, evaluation of total AA content in gonads, liver and muscle of normal and pinealectomised domestic pigeons, Columbia livia has been attempted in both the breeding and non-breeding months.

MATERIALS AND METHODS

Normal healthy domestic pigeons of both sexes obtained from the local animal dealer were acclimated to the laboratory conditions for about a fortnight prior to the experimentation. Pinealectomy was performed during both the breeding and non-breeding months on a total of 24 birds (12 males and 12 females). Simultaneously, same number of birds were sham operated and another eight were maintained intact to serve as the sham and normal controls respectively. All the three groups of birds were

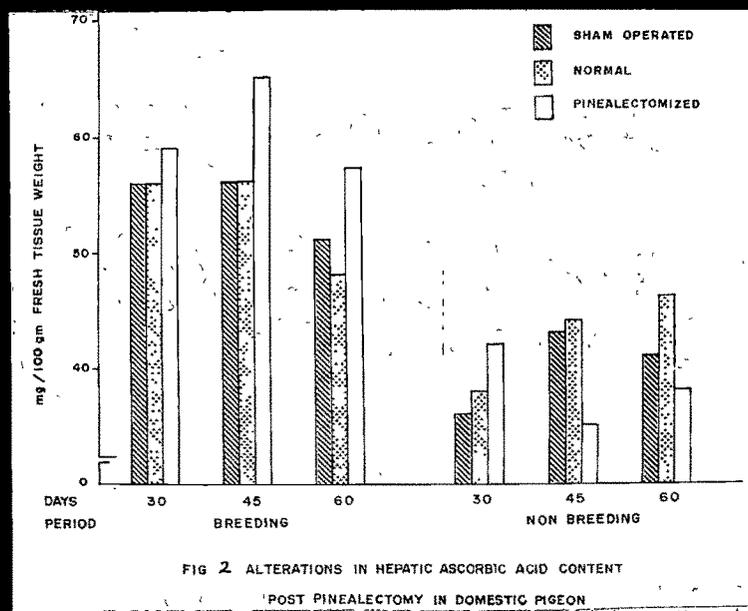
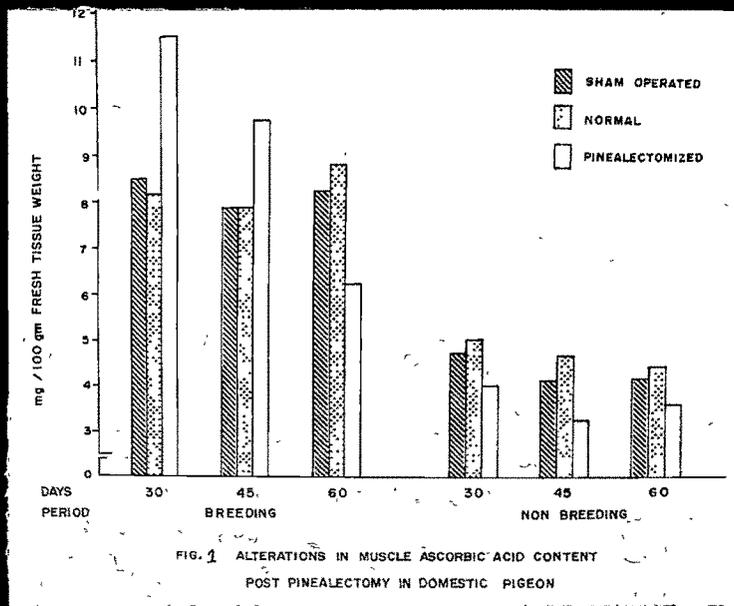
maintained in the aviary on a diet of cereals and water ad libitum. At the end of the experimental periods i.e. 30, 45 and 60 days post-pinealectomy/sham operation, 8 birds from each group were sacrificed under mild ^anesthesia by decapitation and a piece of pectoral muscle, liver and the gonad were excised, blotted free of ^lig tissue fluid and used for quantitative assaying of AA in them by the method of Roe (1954).

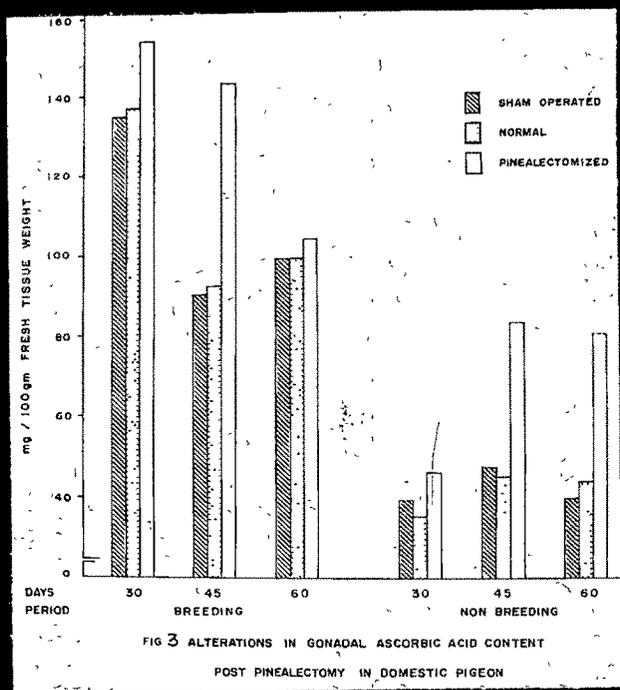
RESULTS

The content of AA in liver, muscle and gonad of normal (C), sham operated (PN) and pinealectomised (PX) birds in the two seasons for the three experimental time periods is recorded in Table-I and figs. 1-3.

SEASONAL VARIATIONS IN NORMAL BIRDS

In general, it becomes apparent that total AA content of all the three tissues was higher during the breeding months and lower during the regression months. Of the three organs, gonads depicted the maximum content and the muscle the lowest. At an average, the non-breeding months showed 62 % , 43 % and 20 % less AA content in gonad, muscle and liver respectively.





CHANGES DUE TO PINEALECTOMY

Pinealectomy brought about differential set of changes in hepatic and muscle AA contents, while in the case of gonad it brought about similar changes during breeding and non-breeding seasons. The pinealectomy induced increment in gonad AA content was at an average about 28-30 % in the breeding season, while in the non-breeding it was as high as 68-70 % . In the case of muscle, the increment during the breeding season and the decrement during the non-breeding season were more or less of the same extent, being about 20-25 % . The PX induced depletion in muscle AA content was evident by the late breeding period itself which corresponds to 60 days post-pinealectomy in the breeding season. Hepatic AA content was increased by an average 12 % during breeding and decreased by 18 % during non-breeding. In contrast to muscle, the decrement in the hepatic AA content was evident only by the mid non-breeding phase corresponding to 45 days post-pinealectomy in the present study.

DISCUSSION

Altered AA content under a variety of experimental conditions such as hypophysectomy, adrenalectomy, gonadectomy etc. is known to occur. While Salmon and Stubbs (1961) have shown reduced AA synthesis after hypophysectomy, Nathani et al. (1971) have observed increased utilization of AA from liver and kidney after adrenalectomy in rats. Similarly, gonadectomy

is also reported to bring about depletion of hepatic and adrenal AA concentration (Chinoy and Rao, 1979). Evidently, prevailing levels of tissue AA content are under the influence of various physiological and endocrine factors. In the present study all the three tissues have depicted increased store of AA during the breeding season which would indicate the faster mobilization in response to the hectic requirements during the breeding activities. Higher levels of AA would also indicate metabolically active status of the tissues during breeding. In the light of the reported increase in tissue AA concentration after administration of male and female sex steroids (Chinoy et al., 1979), the present observation of elevated AA content during the breeding months becomes self explanatory. Obviously the same explanation should hold true for the lower AA content obtained in all the three tissues during the non-breeding months. Moreover, it could also denote decreased mobilization in response to reduced requirement. It is apparent that in domestic pigeons, the tissue AA content in general shows parallel changes with reference to gonadal activation and regression.

Literature on pinealectomy or pineal hormone induced alterations in AA content is scarce. The only reports available are those of Damian^{Elena} et al. (1979a, b) in which they have shown increased AA content in testes of pinealectomised rats and decreased AA content after injection of pineal extract. In the

present study too, pinealectomy is noted to induce significant alterations in AA turnover. In general, pinealectomy is noted to bring about increased AA content in all the three tissues during the breeding season and apparently tends to corroborate the above reports. The changes though similar are however at variance when related with the status of gonads and the role of pineal in gonadal function. Whereas in the case of rat the pineal is essentially antigonadal thereby bringing about gonadal enlargement post-pinealectomy, in the case of domestic pigeons, the pineal is progonadal during the breeding season thereby bringing about gonadal involution post-pinealectomy (Chapter 1). The increment in gonadal AA content noted herein could be accounted for as an event of stockpiling due to reduced utilization in the wake of unaltered rate of mobilization. The same may be true for liver and muscle too. Pinealectomy during the non-breeding phase brought about gonadal activation which clearly denotes an antigonadal role of pineal in this season (Chapter 1). The gonadal activation in pinealectomised birds was marked by increased AA content in their gonads in comparison to the controls and the average increase during the three experimental time periods put together being about 70 %. This substantial increase in AA content denotes the active mobilization and utilization occurring simultaneously in response to a sudden stimulus provided by the removal of the antigonadotrophic action of the pineal. An indication of the utilization of AA for gonadal activation can be obtained from the noted

decrement in gonadal AA content 60 days post-pinealectomy during the breeding season whence gonadal enlargement was discernible. The changes in AA content of gonads post-pinealectomy during both the breeding and non-breeding seasons are well correlated by the observed decrease and increase in the activities of steroid dehydrogenases during the two phases respectively (Chapter 8). Distinctly, the hepatic and muscle AA contents in pinealectomised birds have registered a decrement from the levels characteristic of intact birds during this season. Presumably, depletion from these sources for meeting the requirements of gonadal activation can be a definite possibility. This assumption is further strengthened by the observed increment in the AA content of both these tissues of pinealectomised birds whose gonads had regressed during the breeding season. Some evidence in this wake espousing reciprocal relationship between gonadal hormones and hepatic and other tissue AA contents is available (Chatturvedi and Thapliyal, 1978; Ambadkar and Gangaramani, 1981).