CHAPTER IV

SEASONAL VARIATIONS IN GLYCOGEN AND PROTEIN CONTENTS OF LIVER, GONADS, KIDNEY AND INTESTINE IN TWO SPECIES OF MYNA AS RELATED TO REPRODUCTIVE CYCLES

Glycogen, the polysaccharide, is the main form of energy reserves and it supplies glucose as immediate source of overall metabolic energy demands of an organism. From the voluminous literature on mammalian physiology, it is almost self-evident that liver is the main source of blood glucose (Lehninger, 1984). However, as far as the avian group is concerned, it has been amply proved by several workers (Krebs and Yoshida, 1963; Pearce, 1983; Watford *et al.*, 1981), that the kidneys of these species are actively involved in gluconeogenesis as well as providing glucose to the blood. The presence of inducible phosphoenol pyruvate carboxykinase has been attributed an important role in the process (Ogata *et al.*, 1982). It was therefore, thought desirable to include kidneys also in the present study. Moreover, from available evidence it seems probable that the avian intestine too, under certain altered hormonal and dietary regimes plays a role not only in the uptake of sugars but also of fatty acids, glycerides and cholesterolic compounds subserving the changing energy needs of the birds. Hence, a representive part of the intestine *viz.*- jejunum, was also assessed during the

course of the present work.

Occurrence of glycogen in various cellular elements of testis (Free, 1970) and ovaries (Bjersing, 1977) is a known fact. From these references, it is clear that the location and distribution of glycogen follow certain definite patterns complementary to the process of spermatogenesis and development of ovarian follicles and oocytes. Spermatogenesis is a cyclic process known to be influenced by environmental changes in seasonal breeders. The presence of glycogen in Sertoli cells is related to its role in providing nurishment to developing spermatogenic elements. Ovaries also have different types of cells which change according to stages of development of the ovarian follicles as well as oocytes, and the production of ovarian hormones. It is, therefore, likely that carbohydrate metabolism could vary in different parts of ovary at different phases of reproductive cycle.

Various types of proteins are known to be secreted by different cells of the testes. Sertoli cells secrete a variety of proteins, polypeptides (Steinberger, 1979; Kierszenbaum et al., 1986) including androgen binding protein (ABP) (Frank and Ritzen, 1973; Steinberger et al., 1975; Fritz et al., 1976; Ritzen et al., 1980; Fieldman et al., 1981).

A polypeptide pro-opiomelanocortin found in testis, ovary and tissues of reproduction (Bardin et al., 1987) is known to serve as precursor for a number of secretary peptides of different cells. Kierszenbaum et al.(1986) have reviewed the role of Sertoli cells and peritubular cells in synthesis and secretion of special proteins that are characteristic to each of these cell types. DePhilip and Kierszenbaum (1982) have already reported that these processes are regulated by varying levels of hormones. Testes being meotically active organs, several other proteins associated with meotic processes are also synthesized in the testes (Monesi, 1971; Steinberger and Steinberger, 1980). Different cellular components of testis are known to secrete different types of proteins (Ritzen et al., 1980) according to their functions. On the other hand, the avian ovary, also being meotically active, needs synthesis of particular proteins associated with the process (Tsafriri et al., 1982). The phenomenal deposition of proteins and lipids of yolk, mobilized mainly from the hepatic tissue (McIndoe, 1971) would of necessity be reflected as important changes in the total protein content of the ovary. Under the circumstances, assessment of total protein content of the ovary would be of help in understanding the reproductive cycles, hence, the same was also undertaken. Further, the

ovarian deposition of metabolites in the yolk is also known to be under hormonal regulation (Murton and Westwood, 1977) and, therefore, it is in the fitness of the situation to consider the protein content as related to different phases of reproduction.

Kerstin Uvnäs-Moberg (1989) has tried to put together her experience and knowledge to discuss the role of G.I. tract in growth and reproduction. According to her, the G.I. tract is the largest endocrine gland in the body, and the hormones produced by it exert profound influence in digestion, metabolism, as well as emotions and behaviour. The organism undergoing reproduction usually needs more and highly nutritious food. It is so important that normal reproduction simply cannot take place in the absence of adequate food. Reproduction is always preceded by a period of increased uptake and storage of energy, when changes in the hormone activity of G.I. tract plays a leading role. G.I. tract needs to function optimally during the period of reproduction. Similarly in case of domestic fowl it has been reported that egg laying is held in abeyence due to starvation (Nalbandov, 1970). According to Pomela et al. (1986), oestradiol binding proteins have been reported to be present in the intestine of female rats but not in male rats at E_2 concentration of less than 2-5 nM. In birds also the

demand for food is particularly higher during the period of reproductive season, more so in case of female birds where the production of yolk as well as physical energy for nurturing youngones is comparatively high (Murton and Westwood, 1977). While investigating the changes taking place in liver and gonads, curiosity arose to find out simultaneous changes taking place in the intestine and kidney as well.

In present investigations an attempt was made to look for possibilities of any correlation between these various organs with respect to phases of reproductive activities.

MATERIAL AND METHODS

As described in earlier chapters birds were collected from a local bird supplier and sacrificed as early as possible to avoid effects of caging. A part of median lobe of the liver, gonads, right kidney were taken out, blotted free of tissue fluids and part of all three tissues were added to pre-weighed test tubes containing 30% KOH for the estimation of glycogen. As described in earlier chapter, part of intestine was split open, rinsed repeatedly in cold saline and then added to pre-weighed tube containing 30% KOH. The test tubes were weighed again to find out weight of tissues

and then kept in boiling waterbath till the tissues were completely digested. Test tubes were taken out from waterbath, cooled and to them 2 ml of absolute alcohol was added. The contents were mixed thoroughly, and kept in a refrigerator for about 30 minutes to allow precipitation of glycogen and then centrifuged at 3000 rpm for 10 minutes. Supernatant fluid was poured off carefully and again 2 ml of alcohol was added to it, repeating the same process. The precipitate was then resuspended in redistilled water and different dilutions were taken to estimate glycogen by anthrone method of Siefter et al. (1950).

Remaining part of liver, gonad, intestine and kidney were used for estimation of protein. Tissues were homogenized in chilled mortar and pestle, adding cold redistilled water and proteins were estimated by the Folin-phenol method described by Lowry et al. (1951).

RESULTS

The seasonal variations in glycogen and protein contents of liver, gonads, kidney and intestine of male birds are given in Table 4.1 and Fig. 4a (i) and (ii) and those for female birds in Table 4.2 and Fig. 4b (i) and (ii).

Seasonal variations in Glycogen and Proteins contents in two species of female myna as related to annual reproductive cycles.

	GLYCOGEN mg/100 mg wet tissue weight				PROTEIN mg/100 mg wet tissue weight			
	Liver	Ovary	Kidney	Intestine	Liver	Ovary	Kidney	Intestine
Seasons				Bank myna				
PR	0.151 ±0.02	0.042 ±0.003	0.031 ±0.001	0.038 ±0.01	12.046 ±0.12	10.82 ±0.38	6.912 ±1.18	6.363 ±0.53
BR	0.583 ±0.226	0.215 ±0.02	0.049 ±0.004	0.024 ±0.002	18.058 ±1.34	5.541 ±0.36	10.388 ±0.674	8.084 ±1.04
PS	0.163 ±0.01	0.117 ±0.05	0.02 ±0.015	0.016 ±0.001	10.577 ±2.29	8.205 ±0.93	6.222 ±0.112	3.348 ±0.57
NB	0.243 ±0.03	0.285 ±0.05	0.056 ±0.01	0.053 ±0.005	11.82 ±0.33	15.451 ±2.37	8.321 ±1.029	6.142 ±0.71
				Brahminy myna				
PR	0.265 ±0.048	0.249 ±0.009	0.002 ±0.001	0.055 ±0.016	10.396 ±1.659	12.548 ±1.048	7.279 ±0.7	8.323 ±0.617
BR	0.263 ±0.07	0.571 ±0.12	0.04 ±0.009	0.1 ±0.025	18.07 ±1.192	7.308 ±0.91	12.632 ±1.074	7.534 ±0.386
PS	1.622 ±0.31	0.193 ±0.66	0.005 ±0.0007	0.073 ±0.009	11.46 ±1.00	1.36 ±0.24	7.19 ±0.54	4.2 ±0.14
NB	0.277 ±0.06	0.496 ±0.1	0.054 ±0.01	0.304 ±0.02	13.086 ±0.89	11.006 ±1.74	7.295 ±0.475	6.591 ±1.05

Values expressed as mean±S.E.

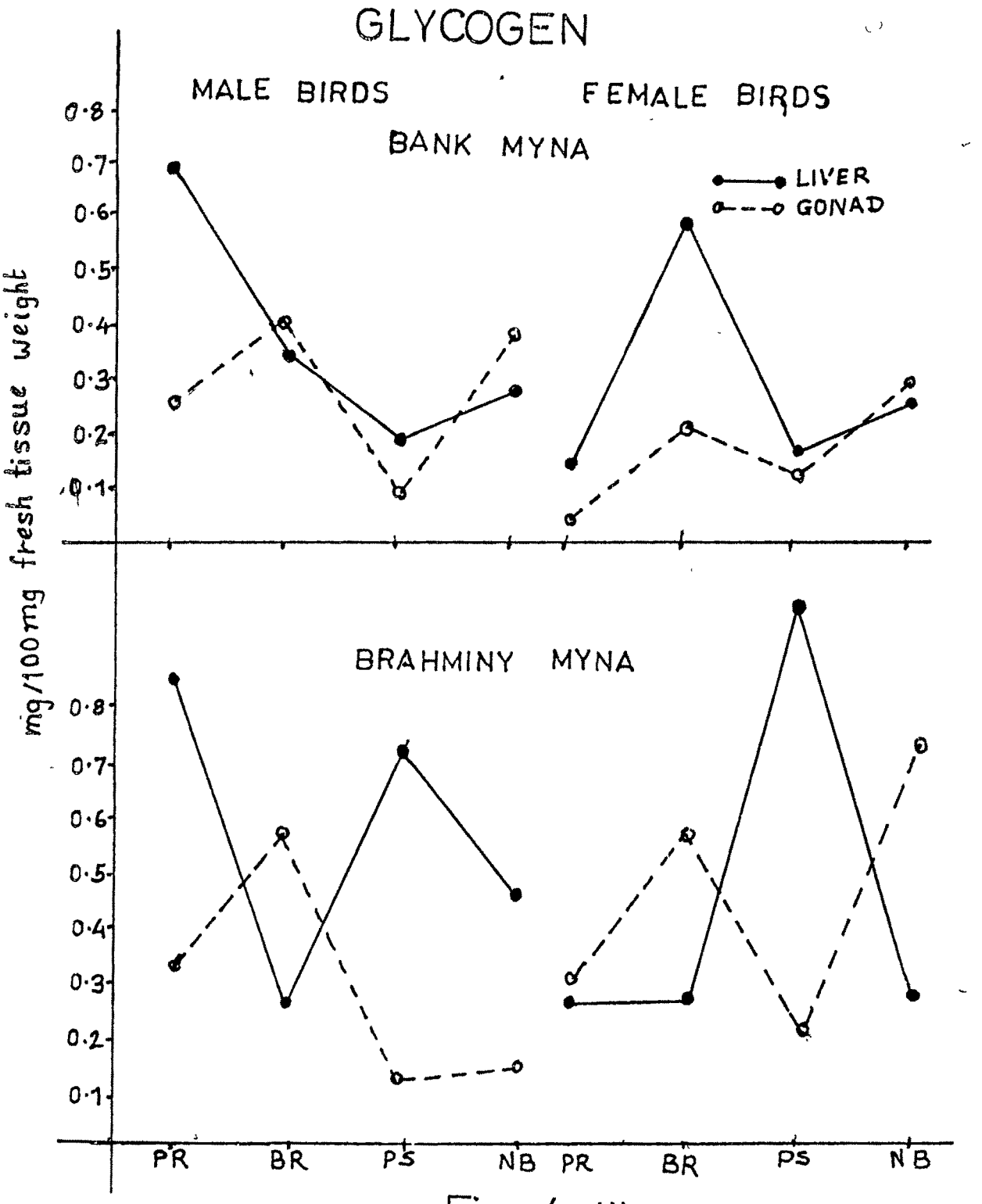
GLYCOGEN
MALE BIRDS
FEMALE BIRDS
BANK MYNA
LIVER
GONAD
mg/100mg fresh tissue weight
0·8
0·7
0·6
0·5
0·4
0·3
0·2
0·1
BRAHMINY MYNA
PR
BR
PS
NB
PR
BR
PS
NB

Fig. 4a(i)

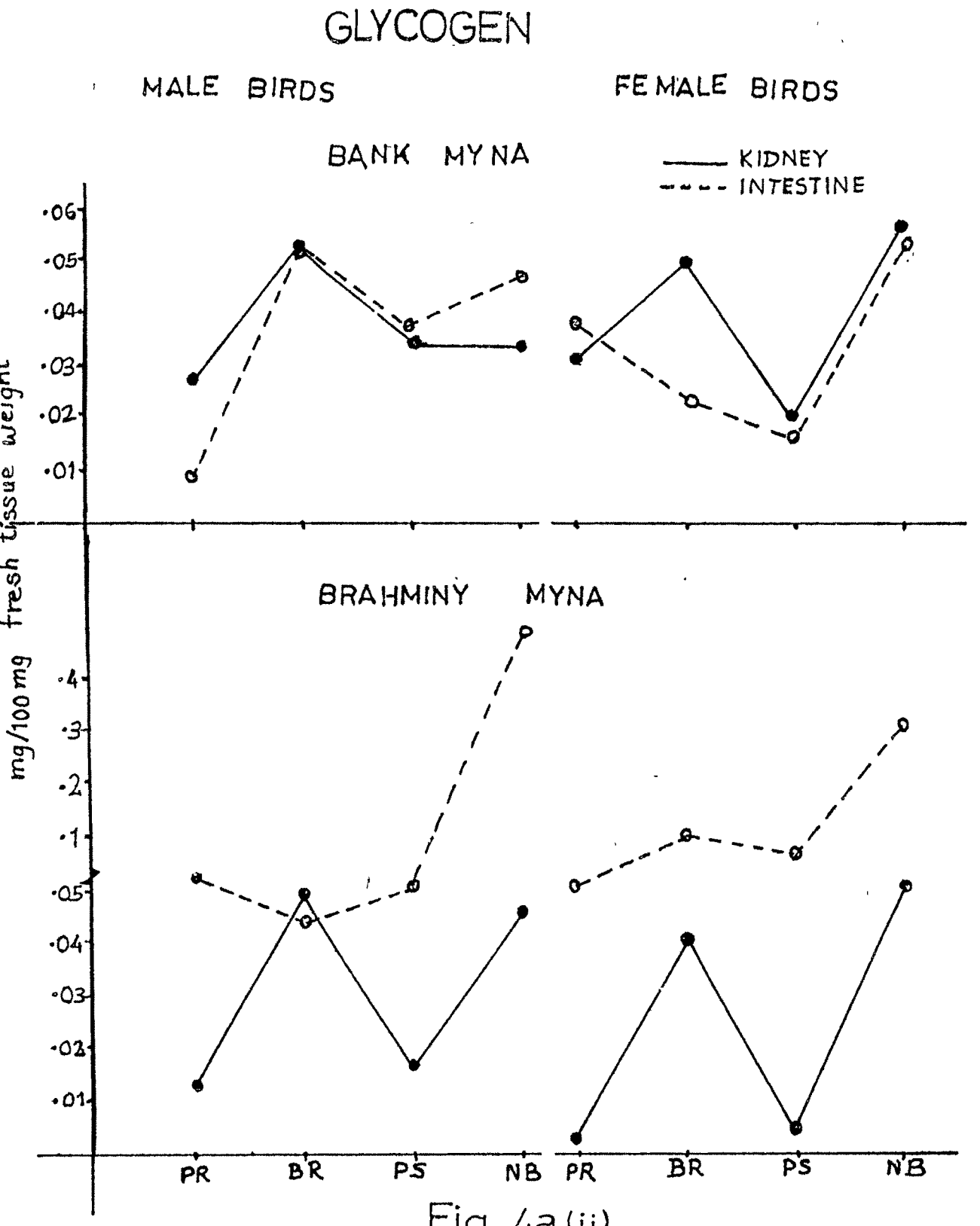
GLYCOGEN
MALE BIRDS
FEMALE BIRDS
BANK MYNA
KIDNEY
INTESTINE
mg/100 mg fresh tissue weight
·06
·05
·04
·03
·02
·01
BRAHMINY MYNA
·4
·3
·2
·1
·05
·04
·03
·02
·01
PR
BR
PS
NB
PR
BR
PS
NB

Fig. 4a (ii)

PROTEIN

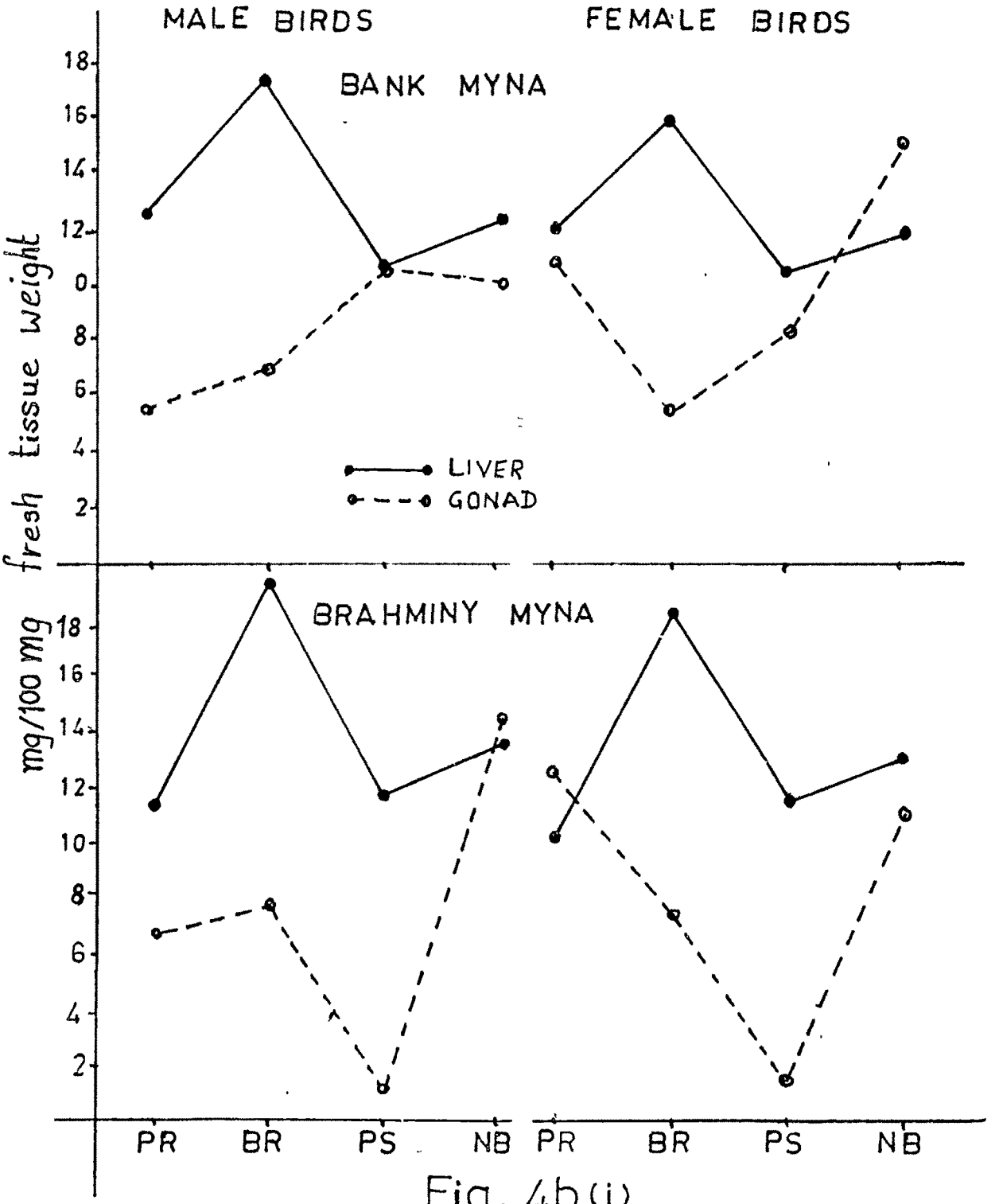

Fig. 4b(i)

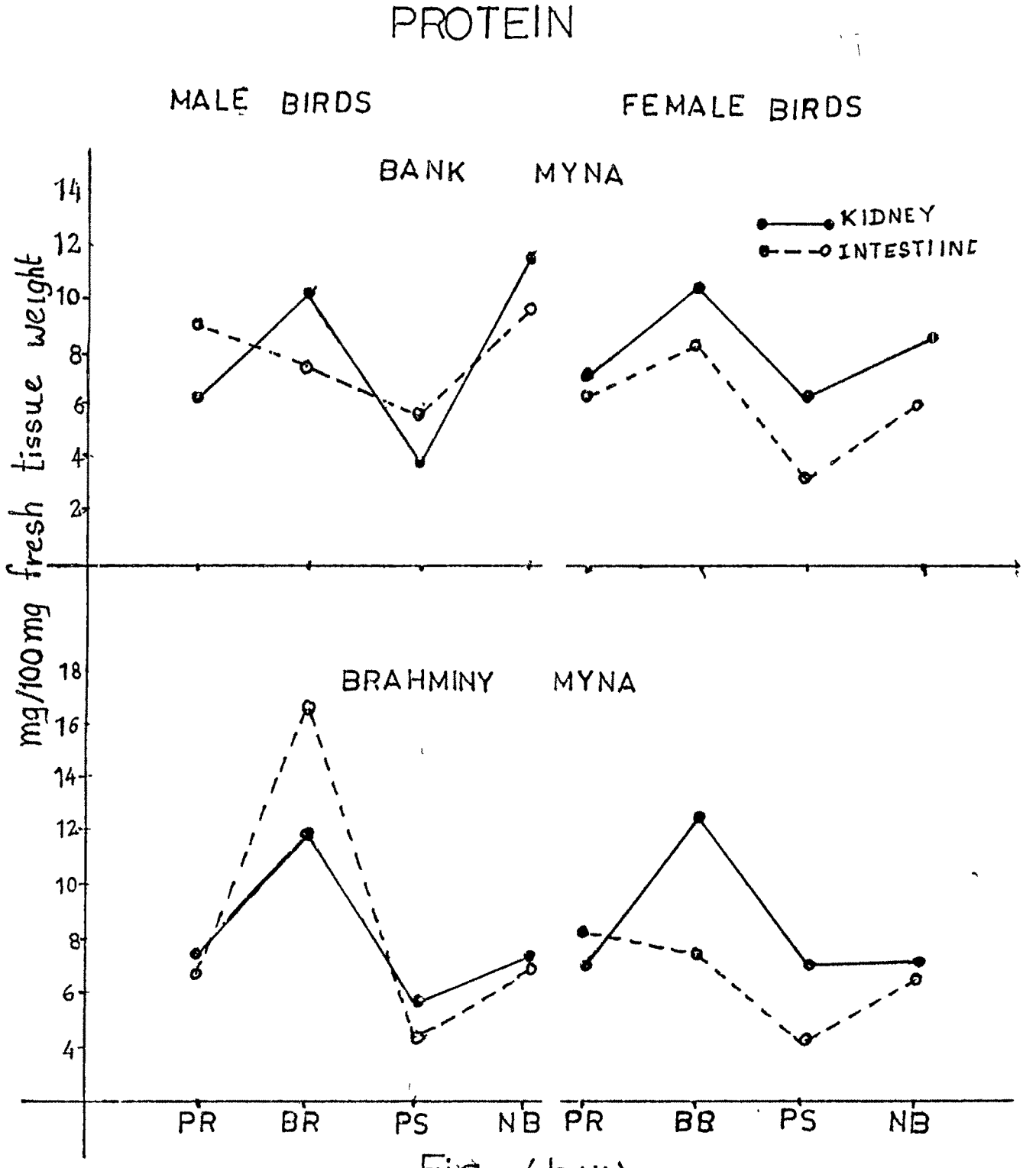
PROTEIN
MALE BIRDS
FEMALE BIRDS
BANK MYNA
KIDNEY
INTESTINE
mg/100mg fresh tissue weight
14
12
10
8
6
4
2
BRAHMINY MYNA
18
16
14
12
10
8
6
4
PR
BR
PS
NB
PR
BB
PS
NB

Fig. 4b(ii)

Glycogen : As seen from the data almost parallel trends were seen in the variation of gonadal glycogen content in both species as well as sexes of mynas, whereas hepatic glycogen levels presented totally differing patterns of variations among species as well as sexes. In Bank myna male birds, hepatic glycogen decreased from PR to BR whereas in female birds glycogen content increased during same transition. A decrease was noted in both sexes from BR to PS, whereas an increase was observed from PS to NB.

In case of Brahminy myna also, the hepatic glycogen content was high during PR in male birds, which dropped during BR, whereas in female birds the glycogen levels as such were lower during PR and were maintained low during following period. During transition from BR to PS glycogen values rose in both sexes; that of female birds rising to a very high level. During following phase - the NB - the value dropped to the level of PR and BR in female birds, whereas though the decrease was not sharp in male birds, it was significant. Male birds of both species exhibited declining levels of hepatic glycogen from PR to BR. Male Bank mynas continued to loose glycogen during BR to PS but the male Brahminy myna showed significant increase in hepatic glycogen content during that period. On the other hand, hepatic glycogen

content registered a rise in case of Bank myna and a lowering in Brahminy myna. As far as female birds are concerned, a remarkable fact that came to light was, non-responsive nature of hepatic glycogen during PR to BR only in the case of female birds of Brahminy myna followed by a sudden and highly significant rise in glycogen build up during BR to PS, which was observed to get depleted equally remarkably from PS to NB. As opposed to this, in case of female Bank myna, there was a significant rise in hepatic glycogen level from PR to BR thereafter there was fall from BR to PS and slight recovery during PS to NB. From these observations it becomes clear that there were obvious species-specific as well as sex-specific differences in the two species of myna.

The testicular as well as ovarian glycogen contents increased during transition from PR to BR, and decreased during BR to PS in both species irrespective of sexes. During transition from PS to NB the gonadal glycogen increased in both sexes of Bank myna and female birds of Brahminy myna; whereas it got levelled off only in the male birds of latter species.

As seen in Tables 4.1 and 4.2 and Fig. 4a (ii) and 4b (ii), intestine showed increasing parallel trends in

glycogen content only during PS to NB in two sexes of both the species. Bank myna male and Brahminy myna female birds exhibited an increase in intestinal glycogen content from PR to BR which decreased during BR to PS in both cases. Though a decrease in intestinal glycogen content was obtained in case of male Brahminy myna and female Bank myna during PR to BR, that during BR to PS in male Brahminy myna showed recovery whereas in case of female Bank myna a further decrease was evident during the same period.

The kidney showed almost parallel trends of variation in male and female birds of both species, except in male birds of Bank myna from PS to NB. In all cases, glycogen levels of kidneys increasedfrom PR to BR whereas decreasedfrom BR to PS. Thereafter, it increased again from PS to NB.

Protein : Protein levels in liver were found to exhibit parallel trends in both sexes as well as species. Protein levels increased from PR to BR, decreased from BR to PS and increased slightly during NB. For gonadal proteins sex-specific differences were prominent during PR to BR, in both species of birds,whereas species-specific differences were manifested during rest of the cycle. In both species testicular proteins increased from PR to BR whereas ovarian proteins decreased at the

same time. Thereafter, in Bank myna gonadal proteins increased from BR to PS in both sexes. However, from PS to NB testicular proteins levelled off but the ovarian proteins increased further in Bank mynas. In case of the other species, gonadal proteins decreased to very low levels from BR to PS and increased very significantly during PS to NB.

Intestinal protein content of male Bank myna and female Brahminy myna showed a decrease during PR to BR whereas female Bank myna and male Brahminy myna exhibited an increase during the same phase. During BR to PS intestinal proteins decreased in both sexes of Bank myna and Brahminy myna, whereas during PS to NB an increase was noted in all cases.

Kidney protein contents exhibited parallel trends in both sexes of the two species studied except that in case of female Brahminy myna during PS to NB. Proteins increased from PR to BR and decreased from BR to PS whereas during transition from PS to NB, both sexes of Bank myna and male birds of Brahminy myna exhibited an increase while only in female birds of latter species the protein level was maintained during last mentioned phase.

DISCUSSION

Female Bank myna - PR to BR

Taking into consideration the overall data presented here, as well as in other chapters of this thesis, the hepatic tissues of female birds exhibited an overall synthetic activity in respect of all the three major constituents viz., protein, glycogen as well as lipids (Chapter I) including TC (Chapter II) the only exception being the EC (Chapter II) component. These synthetic processes naturally put a heavy demand on energy supply (Murton and Westwood, 1977), which probably is supported by increased foraging activity and dietary intake. Here in this connection, one can see that there is increased lipid and AA uptake (Chapter III) via the G.I. tract, that gets manifested into rising hepatic levels. Though not directly assessed here, from the rising glycogen levels in the liver, it could be guessed that intestine also significantly contributes by way of corresponding higher uptake of sugars. One of the remarkable facts about female Bank myna was that the plasma AA levels showed more or less no variations, hepatic level dropped to a certain extent, that of intestine was already stated to be on the higher side, and that in the kidney showed a significant rise. Taken together with the rise in gonadal lipids (Chapter I) including EC and TC

(Chapter II), it could be logically thought to represent substantial renal AA (Chapter III) contribution to the plasma - intestinal contribution to plasma was also being of significance (Chapter III). According to Roy and Guha (1958) in Bank myna the liver is the only site of AA synthesis and not the kidney. The present findings do indicate a role for kidney in AA synthesis; contrary to the opinion of Roy and Guha (1958). This may be due to the fact that these authors neither considered the sex specific differences nor the phases of reproductive cycle. If there is such an addition of AA to the plasma then it should get reflected in plasma AA level (Chapter II). However, the data presented here clearly indicate very little fluctuations in plasma AA levels. Taking into consideration the rise in ovarian total lipids (Chapter I) and TC and EC components (Chapter II) the present author is inclined to believe that there is a much faster uptake of AA by the gonadal tissue and a still faster metabolic involvement in active synthesis of ovarian hormone. This statement finds further support in noticeable ovarian AA depletion (Chapter II). From this discussion it seems that steadily rising levels of ovarian hormones, during this period, in their turn, influence the synthetic processes, referred to earlier, in the liver as well as the kidney and also influence the absorptive functions of the intestine. From the data

presented here it was clear that there was a noticeable drop in the glycogen content of intestinal tissue, which probably was a result of increased energy demands for active absorption and relevant mucosal resynthesis of various products from the digested lumenal contents.

The increase in ovarian glycogen content was probably a manifestation of known glycogen accumulation in the granulosa cells in particular and in other ovarian elements in general (Bjersing, 1977).

The only enigmatic alteration i.e. drop in the ovarian protein content was beyond plausible explanation on the basis of data on hand.

Female Brahminy myna - PR to BR

In general, most of the variations in different parameters of female Brahminy myna were less in intensity than those of Bank myna. Nevertheless, a few departures, to be discussed shortly, were of such nature as could be deemed to be species-specific differences. One such factor concerns the non-responsive nature of liver glycogen during this period, but the same was highly significant leading to an exceptional rise during the next phase. This may be a sort of latent period as far as liver glycogen synthesis is concerned. The other one

concerns with a comparatively steep AA depletion in the ovary. Some are minor differences pertaining to the intestine and kidney. In case of intestine, as opposed to female Bank myna, an insignificant decrease in protein content and increase in glycogen content were noted. There was a slight decrease in the intestinal TL content and AA levels as opposed to significant rise in both these parameters in Bank myna. As far as the species-specific differences are concerned, the kidneys of Brahminy myna registered decrease of some magnitude in the levels of TL, TC, EC as well as AA as opposed to definite increases in Bank myna.

Yet another difference noted was that, as opposed to significant rise in hepatic TC content in Bank myna, that of Brahminy myna showed a noticeable drop. Two of the blood plasma constituents of Brahminy myna viz.- TL and EC exhibited noticeable differences. The EC level indicated a decrease as opposed to increase in Bank myna, whereas the TL content recorded an increase as against almost no variation in case of Bank myna. As far as the gonadal TL component is concerned, the Brahminy myna showed a noticeable decrease as opposed to a certain increase in case of Bank myna. In the light of these facts, as well as on the basis of definite gonadal weight increase and appropriate decrease in GSI (Chapter I) which were almost parallel to that of Bank

myna, it could be tentatively suggested that female Brahminy mynas might be showing a comparatively slow building up of ovarian hormones, as prominently reflected in the already stated differences in responses of the hepatic glycogen as well as total lipid and those of various parameters of the intestine and kidney. However, it should be mentioned here that this needs confirmation through direct blood plasma assays of the hormones concerned with reproduction.

Male Bank myna - PR to BR

When compared to female birds, the males of Bank myna also exhibited an overall synthetic activity in respect of the three major constituents viz. - proteins, glycogen and total lipids (Chapter I and III) including TC and EC (Chapter II and III) of all tissues studied with the exceptions of glycogen content in liver and protein and total lipid of intestine. One of the remarkable facts, seen in present investigation, was the decrease in AA content of all tissues studied during this phase. As mentioned for the female birds, in case of male birds also the biosynthetic processes will need heavy energy supply, which probably in this case is provided by the accelerated sugar uptake by the intestine from digested carbohydrates, coupled with significant hepatic glycogenolysis. The reducing AA

levels (Chapter II and III) in various tissues during this phase probably indicate its greater involvement in various energy demanding metabolic processes of different organs studied and also in enhancing the steroidogenic activity of the gonads. Hepatic lipogenesis is known to be stimulated by high levels of dietary carbohydrates (Griminger, 1976), which is reflected in the higher lipogenesis (Chapter I) in liver. Increase in plasma total lipid (Chapter I) level is probably due to faster intestinal uptake (Chapter III) direct into plasma 'portomicron' fraction (Bensadoun and Rothfeld, 1972) as opposed to usual passage through 'chylomicron' route. In all probability, such portomicron-lipids are picked up by the gonads of the bird as evident from rise of this component therein. Protein and glycogen content also increased in testes.

Male Brahminy myna - PR to BR

Considering the data at hand, it was observed that these birds also exhibited an overall synthetic activity with almost similar changes to those observed in male birds of Bank myna, except considerable rise in proteins and depletion of glycogen levels in the intestine. Another noteworthy difference from male Bank myna was related to total lipid increase in the intestine and almost no lipogenesis by the liver

(Chapter I). Interestingly enough, in this species, the plasma total lipids (Chapter I) did not show an increase but a decrease was obtained. Considered together, these changes probably point to the fact that in this species intestinal uptake of lipids is followed by its entry into chylomicrons rather than portomicrons, in stark difference to what was obtained in the case of Bank myna. AA showed more or less similar decreasing trend to that of Bank myna. In contrast to Bank myna, all Brahminy myna tissues under study exhibited a general decreasing trend in TC. In the light of these observations it could be suggested that in Brahminy myna the overall energy demands of the tissues studied were met with not only through hepatic glycogenolysis, as in Bank myna, but were also supplemented in good measure by the plasma lipids. However, in this case, as in Bank myna, the involvement of AA was similar. From the comparatively less marked testicular AA depletion (Chapter II) in this species, it is apparent that there was a slower rate of testicular hormone synthesis.

Female birds - BR to PR

In general, low levels were seen during this phase in female birds of both species, except a highly significant rise in glycogen level in liver of Brahminy myna (glycogenesis), increase in ovarian proteins and

increase in intestinal TC levels of Bank myna. Accumulation of AA in the gonads (Chapter II) of both species was probably due to non-utilization of the vitamin for steroidogenesis whereas the rising levels of AA in the hepatic tissue were indicative of reduction in rate of release of this vitamin. However, taking into account the noticeable rise in blood AA level (Chapter II), it could be said that it was possibly due to two reasons — (i) continued renal synthesis and release of AA, (ii) slow rate of pick up from blood by the gonads as well as other tissues of the body. So far as the intestine is concerned, it could be seen that it becomes free from the influence of ovarian hormones (referred to in the first part of this discussion) and hence the rate of absorption of AA was seen to be reduced considerably. From this it is apparent that the renal tissue once stimulated (PR) remains active as far as AA synthesis and release is concerned through BR, but the intestine reconciles. Low levels of proteins, glycogen and total lipids in liver, kidney as well as intestine of the female mynas, except remarkable hepatic glycogen rise in Brahminy myna, and rising levels of plasma TL in all probability are indicative of greater metabolic emphasis on utilization of circulating lipids as the major source of overall energy supply during BR to PS; more so in case of Brahminy myna. Further, from the

data it is apparent that the kidneys in both species exhibit gluconeogenesis and accelerated release of glucose into blood. However, the hepatic contribution of glucose (glycogenolysis) was obvious in case of Bank myna, but in the case of Brahminy myna liver does not contribute at all.

In the light of these observations, it can be said that, during BR to PS, the Bank mynas exhibited mixed metabolic economy involving utilization of lipids as well as carbohydrates whereas in the case of the other species it is more or less exclusively lipid centred. Apparent loss of gonadal lipids (Chapter II) in both the species is a pointer to loss due to ovulation.

Here it would be of importance to mention one of the important species-specific differences. Brahminy myna showed further decrease in gonadal proteins, glycogen as well as total lipid content. In all probability, these changes show a comparatively early setting in of ovarian regression in Brahminy myna as compared to the Bank myna. This was corroborated by casual field observations by the present author.

Female birds - PS to NB

Most of the alterations in respect of the parameters studied during the transition from PS to NB

indicated a generalized rising trend in both the species, except decrease in plasma and hepatic AA levels (Chapter II) and gonadal weight and GSI (Chapter I). There was an exceptionally remarkable fall in hepatic glycogen content in Brahminy myna coupled with rise in all lipid components (Chapter I and III). In the light of the already noted simultaneous changes in metabolites of other tissues it could be suggested that the overall energy supply situation in female Brahminy myna shifts from mainly lipid dependent state to carbohydrate dependent energy economy supporting the various synthetic and general metabolic activities.

Male birds - BR to PS

Similar to female birds, male birds exhibited an overall decrease in overall biosynthetic activities during the transition from BR to PS, with exceptional accumulation in testicular proteins in Bank myna and a significant rise in hepatic glycogen in Brahminy myna (glycogenesis). Lipid components of gonads (Chapter I) showed increase in both species indicating the beginning of post-spermatogenic accumulation. As seen in female birds, in male birds also, AA levels increased in liver, plasma and gonads (Chapter II), which can also be due to reduced utilization of the vitamin for gonadal hormones synthesis. With reference to AA levels, the kidneys of

the two species of myna exhibited opposite trends (Chapter III). It was noted that there was a slight fall in Bank myna and some accumulation in Brahminy myna. These trends probably indicated cessation of AA release from the kidneys of Brahminy myna but continuation of its release to a lesser extent from kidneys of Bank myna. If this is read together with the levels in hepatic tissue, plasma level and gonads in both species; all the observations point to the fact that there was comparatively much reduced general uptake of AA from plasma in case of Brahminy myna as compared to Bank myna. Increasing levels of gonadal AA indicate reduced steroidogenesis by the gonadal tissue.

Taking into consideration the changes taking place in different metabolites of gonads of both species, it can be said that, as seen for Brahminy myna female birds, in male birds also gonadal regression sets in comparatively earlier than male Bank myna.

In case of Bank myna, liver exhibited continued glycogenolysis, that being the major source of energy for general metabolism during this phase. In Brahminy myna, the liver was seen to build up glycogen, kidney being the possible source of glucose (gluconeogenesis) supplemented by the dietary source. This difference in respect of general metabolic pattern seems to be a

species-specific difference, as such a difference was also seen in female birds of Brahminy mynas. In both the species intestine seemed to play its normal role in absorption of protein, carbohydrates as well as lipids as the foraging activity of male birds increase during this period.

Male birds — PS to NB

During the transition from PS to NB, as noted in the case of female birds of both species, male birds also showed generalized rising trends in almost all the parameters studied, except decreasing trends in plasma and hepatic AA levels. However, it should be pointed out here that one obvious difference was concerning the significant decrease in hepatic glycogen content of male Brahminy mynas only, during this phase. This trend was similar to that also seen in female Brahminy mynas, hence, it was a species-specific character.

In conclusion, it may be stated that, gonadal regressive changes in Brahminy mynas set in comparatively earlier than in case of Bank mynas. Apart from this obvious species-specific difference, others concerning variations in the metabolites studied here, underlying the whole process of reproduction, have also been noted. It was revealed that the gluconeogenic role of kidneys

was influenced by the hormonal melieu in different ways during some of the phases of reproductive cycle. Similarly the rates of intestinal absorption of carbohydrates and lipids and the entry of lipids either by way of 'chylomicrons' of 'portomicrons' were affected.