CHAPTER X

THYROID AND TAIL REGENERATION : LOCAL AND SYSTEMIC ALTERATIONS IN PROTEIN CONTENT AND ACTIVITIES OF TRANSAMINASES UNDER DIFFERENTIAL FUNCTIONING OF THYROID IN THE SCINCID LIZARD, *MABUYA CARINATA*

Protein metabolism which is fundamentally linked with development has been well documented to be of pivotal significance in regeneration of lacertilian tail (Shah *et al.*, 1977 a; Ramachandran *et al.*, 1980 b). Though *in loco* protein anabolism can easily be expected, coordinate occurrence of this feature in liver and muscle is a novel and interesting aspect which has been elucidated by the works of Ramachandran *et al.*, 1980 b and Chapter V. Further, adaptive alterations in transaminases too have been observed to occur in the regenerate as well as in the two visceral organs, *viz.*, liver and skeletal muscle (Chapter V). These observations have given relevance and enabled to substantiate the concept of a systemic involvement in support of the *in loco* histophysiological alterations characteristic of regeneration, which is evolved from the many investigations undertaken in this laboratory in the past few years. Since there appears to be a coordinate involvement of systemic factors in concert with the local factors, the operation of certain regulatory factors can well be considered possible. Many hormones are known to exert

control over metabolic activities of animals, especially thyroxine, the thyroid hormone. In this wake alterations induced in protein metabolism have been evaluated, both systemically as well as *in loco* by measuring quantitatively the total protein content of the regenerate, liver and skeletal muscle during various stages of tail regeneration in the Scincid lizard, *Mabuya carinata* under three different experimental regimes of euthyroidism, PTU induced hypothyroidism as well as T4 replacement. Since transaminases are considered to be enzymes associated with protein metabolism and as enzymes are known to be under the perview of hormonal regulation, the activity levels of glutamate-pyruvate (EC 2.6.1.2) and glutamate-oxaloacetate transaminases (EC 2.6.1.1) (GPT and GOT) were also assayed in the three tissues of normal euthyroidic, PTU induced hypothyroidic as well as T4 replaced groups of animals.

MATERIALS AND METHODS

Healthy Mabuyas of both sexes obtained from Hyderabad, India and allowed to get acclimated to the laboratory conditions were kept on insect diet. Animals were subjected to chemical thyroidectomy and thyroxine replacement therapy as described in Chapter I. Tails were autotomized by pinching off at about 1.5-2.0 cms distal to the vent. Animals were then sacrificed under mild anaesthesia at fixed intervals of

3, 5, 7, 10, 12, 15, 25, 40 and 60 days post-autotomy.

Liver, skeletal muscle and normal or regenerating tail, as the case may be, were quickly removed and homogenized in ice-cold redistilled water. A 2% homogenate was prepared for liver and skeletal muscle whereas in the case of tail a 4% homogenate was found satisfactory. Quantitative estimation of protein content and activities of transaminases (GPT and GOT) were done according to the methods described in Chapter V.

For each day and each tissue specified a total of five to seven estimations were made. The mean and standard deviation were obtained and students' 't' test was used to determine statistical significance.

RESULTS

Tables 1-3 and Figs. 1-9 depict the total protein content and activity levels of glutamate-oxaloacetate and glutamate-pyruvate transaminases of regenerating tail as well as liver and skeletal muscle in the three groups of animals *viz.*, control euthyroidic (group A), PTU induced hypothyroidic (group B) and PTU treated and T4 replaced (group C).

Tail : (Normal and Regenerating)

The caudal protein content of T4 replaced group shows

Table 1. Level of Protein in the regenerate, liver and skeletal muscle during tail regeneration under euthyroidic, hypothyroidic and T4 replaced conditions in M. carinata.

(Values expressed as mg protein/100 mg of tissue weight)

Periods of tail regeneration in days	TAIL			LIVER			MUSCLE		
	Control Group (A)	PTU Group (B)	PTU + T4 Group (C)	Control Group (A)	PTU Group (B)	PTU + T4 Group (C)	Control Group (A)	PTU Group (B)	PTU + T4 Group (C)
N	10.38 ± 0.52	7.91 ±0.59	8.54 ±0.37	15.15 ±0.39	19.87 ±0.98	19.9 ±0.81	12.33 ±0.46	12.53 ±0.55	10.38 ±0.74
3	8.01 ±0.27	10.45⁂ ±0.97	7.91 ±0.18	16.63* ±0.41	22.45* ±1.08	20.53 ±0.69	13.23 ±0.79	15.05@ ±0.57	11.61 ±0.39
5	12.4* ±0.56	7.03 ±0.44	8.6 ±0.39	18.2*@ ±0.62	18.5⁂ ±0.71	17.18⁂ ±0.75	13.71 ±0.82	10.61@ ±0.38	11.09 ±0.58
7	13.6*@ ±0.96	8.68 ±0.93	9.34* ±0.47	19.95⁂@ ±0.55	21.2 ±0.59	19.53 ±1.47	15.55@ ±0.87	10.3⁂@ ±0.37	11.39 ±0.56
10	15.47*@ ±1.56	9.99 ±1.32	11.81*@ ±1.04	20.55*@ ±1.04	19.43 ±0.62	20.35 ±1.17	16.48*@ ±0.72	15.34@ ±0.99	12.9@@ ±0.39
12	17.13*@ ±1.23	8.34 ±0.57	14.63*@ ±1.07	20.93*@ ±0.81	20.55 ±0.79	21.25 ±0.82	16.07*@ ±0.66	16.25*@ ±0.85	11.38@@ ±0.48
15	15.46*@ ±0.86	8.65 ±0.34	15.23*@ ±1.26	20.48*@ ±0.38	19.43 ±0.57	18.9 ±0.1	16.42*@ ±0.49	12.13 ±0.45	11.33 ±0.55
25	10.03 ±1.23	10.78*@ ±0.54	13.64*@ ±0.89	19.63@@ ±0.6	17.58 ±0.91	16.5 *@ ±0.56	15.56@@ ±0.43	14.61⁂ ±0.88	12.78@@ ±0.39
40	12.71 ±1.27	7.9 ±0.81	12.34*@ ±0.95	20.18*@ ±0.59	15.05*@ ±0.59	19.45 ±0.45	14.39⁂ ±0.81	8.05*@ ±1.21	11.15@@ ±0.42
60	12.92 ±1.64	7.01 ±0.85	10.3* ±1.83	18.08*@ ±0.73	20.23 ±0.71	13.4 *@ ±1.36	12.81 ±2.02	7.71*@ ±0.44	10.7 ±0.81

* $P < 0.01$; ⁂ $P < 0.005$; @ $P < 0.0025$; @@ $P < 0.001$; *@ $P < 0.0005$

N - Normal (Pre-autotomy state)

Table 2. Quantitative levels of Glutamate pyruvate transaminase in the regenerate, liver and skeletal muscle during tail regeneration under euthyroidic, hypothyroidic and T4 replaced conditions in M. carinata.

(Values expressed as μM Glutamate formed/mg protein/min.)

Periods of tail regeneration in days	TAIL			LIVER			MUSCLE		
	Control Group (A)	PTU Group (B)	PTU + T4 Group (C)	Control Group (A)	PTU Group (B)	PTU + T4 Group (C)	Control Group (A)	PTU Group (B)	PTU + T4 Group (C)
N	0.53 ±0.09	0.43 ±0.12	0.56 ±0.11	2.27 ±0.36	1.77 ±0.31	2.43 ±0.36	0.88 ±0.18	0.61 ±0.06	1.02 ±0.67
3	0.88*@ ±0.28	0.97*@ ±0.19	0.67 ±0.11	2.79* ±0.14	1.71 ±0.25	1.51⁂ ±0.22	1.32* ±0.22	0.94* ±0.11	1.16 ±0.25
5	0.39 ±0.05	0.95*@ ±0.23	0.67 ±0.19	2.37 ±0.49	2.43* ±0.28	1.87 ±0.56	1.51* ±0.37	1.86*@ ±0.34	1.49@ ±0.24
7	0.47 ±0.13	0.97*@ ±0.27	0.56 ±0.13	1.5* ±0.29	1.87 ±0.49	1.67* ±0.14	2.12*@ ±0.18	2.19*@ ±0.25	2.26*@ ±0.45
10	0.41 ±0.12	0.59 ±0.23	0.61 ±0.11	1.01*@ ±0.42	1.53 ±0.27	1.31* ±0.37	0.92 ±0.11	1.09*@ ±0.06	0.86 ±0.31
12	0.36★ ±0.03	0.24 ±0.06	0.83 ±0.21	1.06*@ ±0.15	0.45*@ ±0.17	1.49* ±0.28	0.81 ±0.08	0.94* ±0.15	1.24 ±0.36
15	0.41 ±0.07	0.93*@ ±0.11	0.42 ±0.11	1.06*@ ±0.19	1.46 ±0.05	1.91 ±0.22	0.73 ±0.13	1.67*@ ±0.18	1.26 ±0.16
25	0.58 ±0.13	0.56* ±0.11	0.38★ ±0.05	1.58* ±0.09	1.9 ±0.21	2.11 ±0.47	1.46*@ ±0.31	1.25@@ ±0.31	1.41 ±0.52
40	0.69 ±0.11	0.82*@ ±0.21	0.91* ±0.39	2.49 ±0.26	2.08 ±0.37	2.93*@ ±0.69	1.95★@ ±0.55	1.55*@ ±0.35	1.49* ±0.39
60	0.48 ±0.07	0.36 ±0.15	0.9 ★ ±0.12	2.38 ±0.45	1.86 ±0.1	2.41 ±0.48	1.01 ±0.26	0.57 ±0.13	1.44 ±0.44

* $P < 0.01$; ⁂ $P < 0.005$; @ $P < 0.0025$; @@ $P < 0.001$; *@ $P < 0.0005$

N - Normal (Pre-autotomy state).

Table 3. Quantitative levels of Glutamate-oxaloacetate transaminase in the regenerate, liver and skeletal muscle during tail regeneration under euthyroidic, hypothyroidic and T4 replaced conditions in M. carinata.

(Values expressed as uM Glutamate formed/mg protein/min.)

Periods of tail regeneration in days	TAIL			LIVER			MUSCLE		
	Control Group (A)	PTU Group (B)	PTU + T4 Group (C)	Control Group (A)	PTU Group (B)	PTU + T 4 Group (C)	Control Group (A)	PTU Group (B)	PTU + T4 Group (C)
N	3.65 ±0.81	5.57 ±0.35	4.48 ±0.69	5.32 ±0.37	6.34 ±1.17	6.22 ±0.51	5.59 ±0.66	7.05 ±0.56	6.99 ±1.17
3	3.96 ±0.77	3.91*@ ±0,51	3.19* ±1.04	6.51 ±1.26	6.21 ±0.76	6.43 ±0.55	5.85 ±2.06	6,22 ±0.29	5.13 ±0.86
5	2.34*@ ±0.576	2.62*@ ±0.65	2.34* ±1,17	4.93 ±1,47	6.37 ±0.49	5.97 ±1.19	4.91 ±1.16	9.29 ±1.31	6.1 ±1.22
7	1.22*@ ±0.344	2.5*@ ±0.78	0.99*@ ±0.13	4.56 ±0.58	5.34 ±0.48	5.62 ±0.86	4.76 ±1.33	7.21 ±1.01	4.43* ±0.51
10	1.53 ±0.34	1.7 ±0,15	1.26*@ ±0.34	3.16* ±0.85	2.9*@ ±0.7	3.99@ ±1.29	3.26* ±0.75	4.36*@ ±0.43	4.22@ ±1.06
12	1.001*@ ±0.067	2.37*@ ±0.86	1.99*@ ±0.53	3.05* ±1.14	4.27*@ ±0.68	3.62*@ ±0.55	3.87* ±0.59	4.31* ±1.41	3.42*@ ±1.55
15	0.35*@ ±0.04	0.998*@ ±0.45	1.15*@ ±0.69	3.54*@ ±0.07	5.94 ±2.35	7.17 ±1.42	1.9 *@ ±0.68	5.38 ±1.48	5.94 ±1.46
25	1.67*@ ±0.68	1.21*@ ±0.32	3.17@ ±0.12	4.13* ±0.48	5.59 ±1.22	6.27 ±0.95	3.65* ±0.31	3.26*@ ±0.79	7.37 ±1.87
40	3.64 ±0.38	2.11*@ ±0.63	2.58*@ ±0.32	4.38 ±0.86	5.19 ±1.27	4.06*@ ±0.41	4.08 ±1.35	5.79 ± 0.57	4.86* ±1.07
60	3.67 ±0.25	3.31*@ ±0.35	4.69 ±0.92	3.99 ±1.01	5.35 ±0.66	8.52 ±2.42	5.97 ±1.44	4.01*@ ±0.54	7.42 ±0.87

* $P < 0.01$; * $P < 0.005$; @ $P < 0.0025$; @ $P < 0.001$; * @ $P < 0.0005$

N.- Normal (Pre-autotomy state)

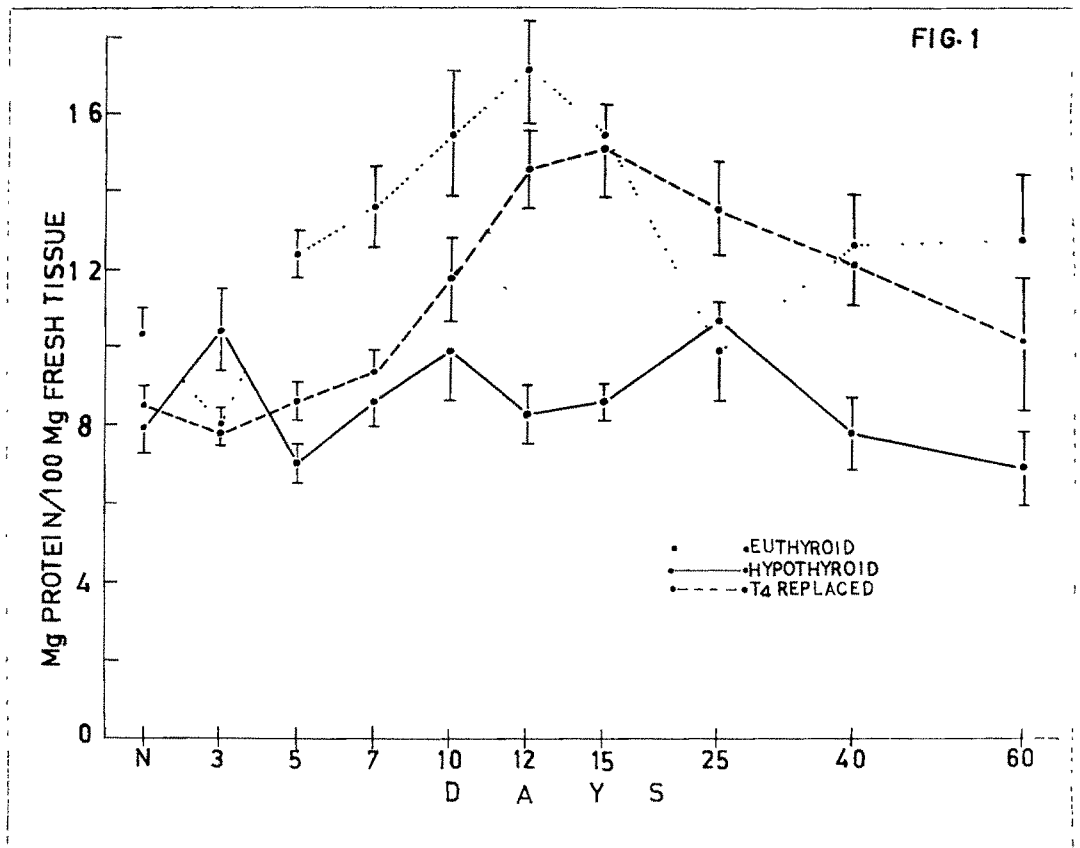

Fig. 1. Changes in protein content in the regenerate during tail regeneration under control euthyroidic, PTU induced hypothyroidic and T4 replaced conditions in M. carinata.

in general an intermediate level, with the control group showing relatively higher level and the hypothyroidic animals showing lowest level in the unautotomized condition. After an initial drop as observed on 3rd day post-autotomy in groups A and C, the protein content increased linearly in both the groups with the peak level being attained on 12th and 15th days respectively in group A and C animals. The later periods of tail regeneration was marked by a continuous decreasing trend with the protein content on 60th day being slightly above normal in both the groups. However, the group B animals have shown an immediate increase after tail autotomy as observed on 3rd day followed by a drop to the subnormal level on 5th day. From this subnormal level, the protein content showed two peaks of increase on 10th and 25th days. By 40th day the protein content fell and by day 60, it was very much subnormal.

After an initial 2-3 fold increase in GPT level immediately after autotomy on 3rd day in group A animals, the enzyme level fell to a subnormal level as observed from 5th to 15th day. Consequently the enzyme activity showed an increase reaching a peak on 40th day, and on day 60 it settled to a subnormal level. The enzyme levels in group B animals have shown an initial tremendous increase on the 3rd day which was maintained more or less so till 7th day. This was followed by a sharp drop to the lowest subnormal level on the 12th through 10th day.

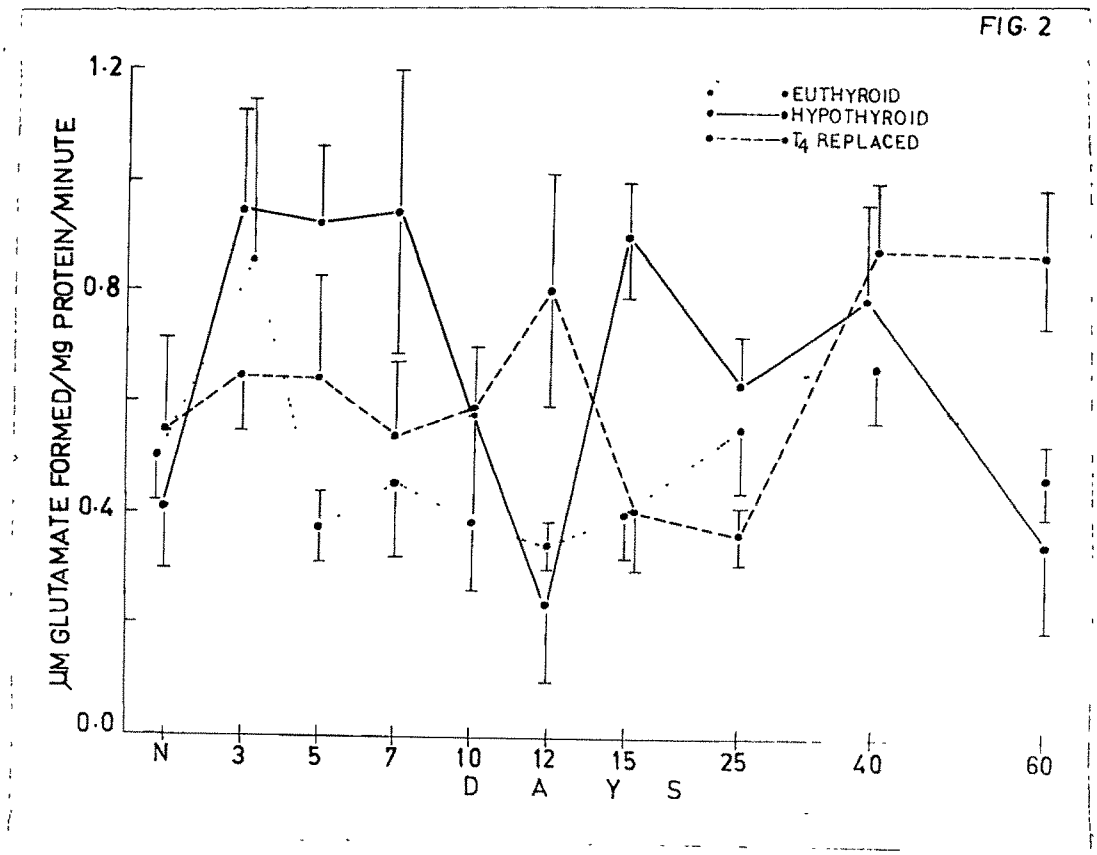

Fig. 2. Changes in glutamate-pyruvate transaminase (GPT) activity in the regenerate during tail regeneration under control euthyroidic, PTU induced hypothyroidic and T4 replaced conditions in M. carinata.

The remaining periods of regeneration showed relatively high levels of enzyme activity from 15th through 40th days, but by day 60, its activity registered a subnormal level. Whereas in group C animals a slightly supranormal plateau was maintained on 3rd and 5th days, it further rose to a still higher level on the 12th day with a slight fall on the 7th day. Thereafter, the enzyme activity again fell to the lowest subnormal level on the 25th day through 15th day and then again rose to the highest level on the 40th day which was maintained steadily thereafter.

In the unautotomized condition the T4 replaced group of animals had a higher basal level of GOT activity, while PTU treated animals had highest basal level as compared to the control animals. Interestingly the activity levels of GOT were more or less similar in the three experimental groups and at no stage did the enzyme register a supranormal level in any of the three groups of animals. The enzyme level was found to decline gradually but steadily in all the three groups of animals till about 15th day whence the lowest levels were registered. However, the euthyroidic animals showed a slight increase on the 10th day which is also registered by the T4 supplemented animals. This increasing trend was noted to continue in the T4 replaced group of animals even on the 12th day while the PTU fed animals depicted the increase only on the 12th day. From the lowest

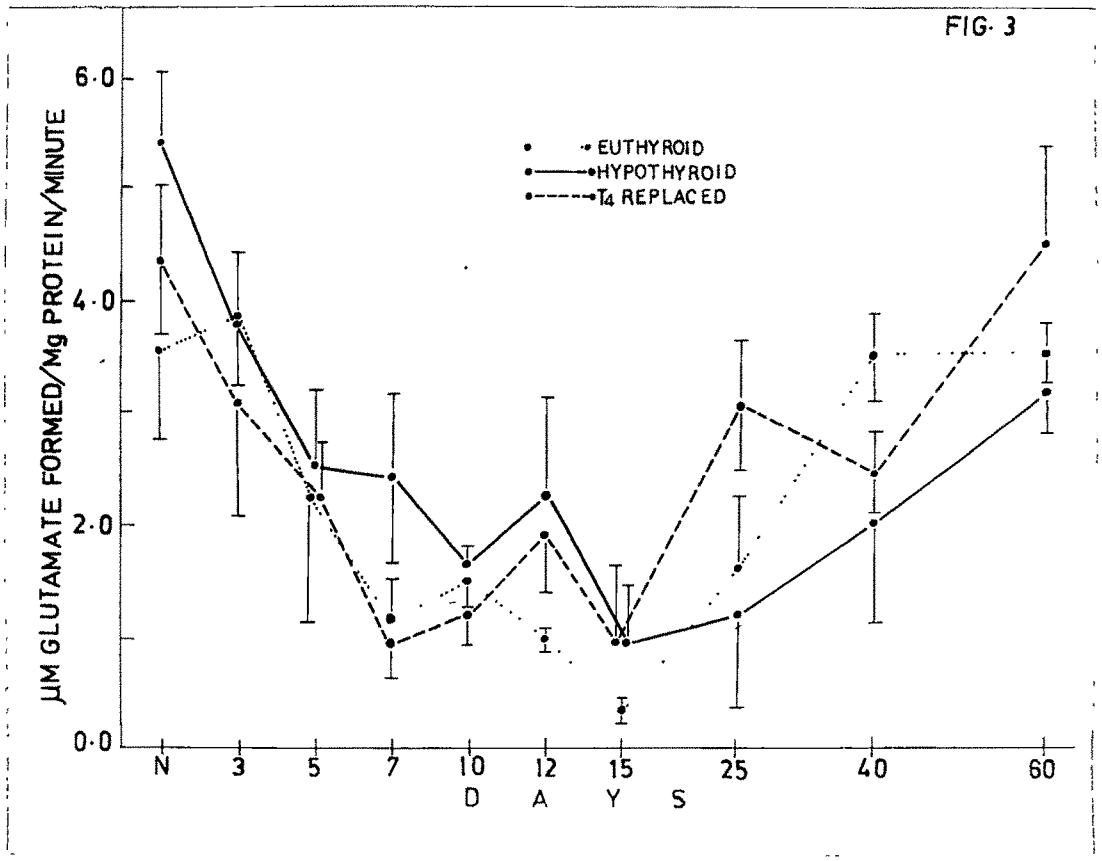

Fig. 3. Changes in glutamate-oxaloacetate transaminase (GOT) activity in the regenerate during tail regeneration under control euthyroidic, PTU induced hypothyroidic and T4 replaced conditions in M. carinata.

subnormal levels on the 15th day the enzyme activity started increasing for the rest of the periods of regeneration ultimately reaching near normal levels of enzyme activity on the 60th day in A and C groups of animals and subnormal level in the case of B group of animals.

Liver :

In the unautotomized condition, group B and C animals were shown to have a high protein content in the liver as compared to the control animals. In control euthyroidic animals subsequent to tail autotomy hepatic protein content registered a continuous increase till the 12th day. Thereafter it reduced very gradually and on day 60, it tended to remain very much above normal. In contrast, in both B and C groups of animals the hepatic protein content increased on the 3rd day, dropped to subnormal levels on 5th day and rose again on the 7th day. Since then the hypothyroidic animals showed a more or less continuous decline to reach the lowest subnormal level on the 40th day, whereafter it increased to more or less the pre-autotomy level by 60th day. However, the T4 replaced group of animals depicted a gradual increase in hepatic protein content between 7th and 12th days whence the maximal level was attained. Thereafter, it fell to a significant subnormal level on 25th day, increased to pre-autotomy level on 40th day and again declined drastically by 60th day.

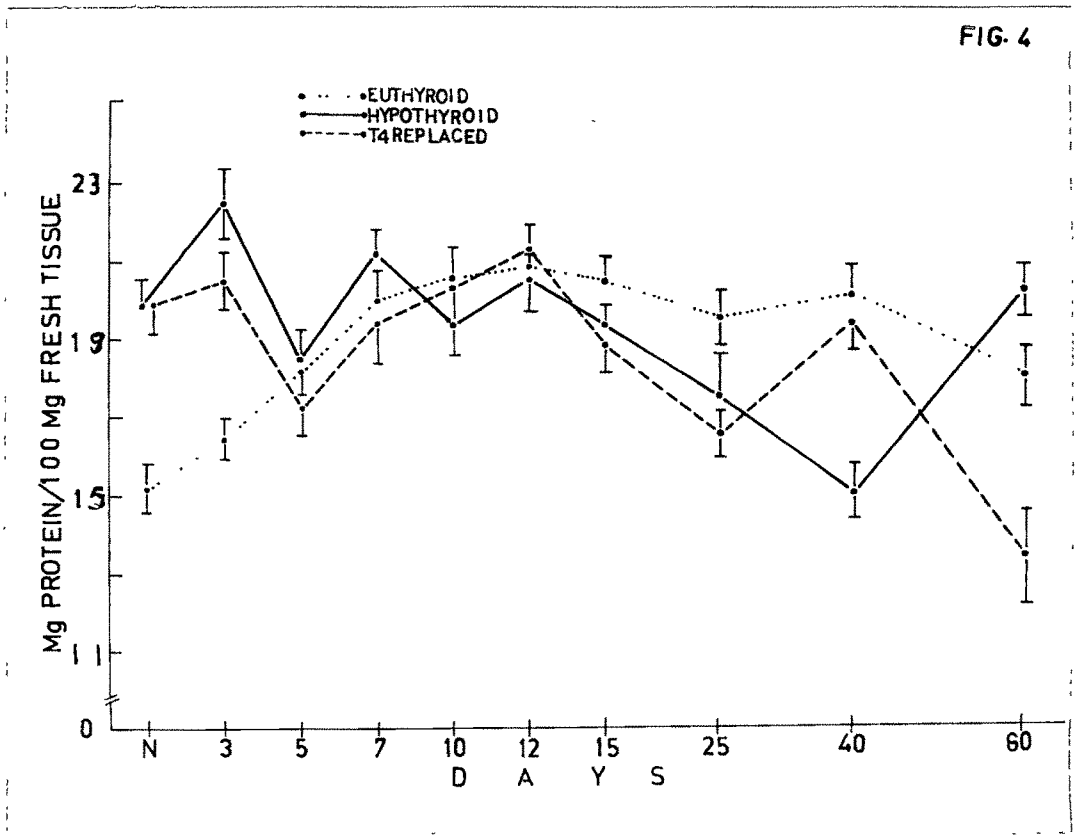

Fig. 4. Changes in protein content in liver during tail regeneration under control euthyroidic, PTU induced hypothyroidic and T4 replaced conditions in M. carinata.

The activity levels of hepatic GPT in all the three groups of animals depicted a similar pattern of changes and remained subnormal all throughout tail regeneration. There was an initial fall from 5th day post-autotomy which persisted till 10th day in A and C groups of animals and till 12th day in group B animals which was more pronounced. Since then the enzyme activity started increasing gradually in all the three groups till corresponding near normal levels were attained by 60th day. During the first 5 days the enzyme activity tended to be above normal in A and B groups of animals.

Hepatic GOT activity too depicted more or less a similar pattern. Both the B and C groups of animals showed declining enzyme activity till lowest subnormal levels were attained on 10th and 12th days respectively. On the other hand, the control animals (group A) showed a spurt in enzyme activity on the 3rd day before falling gradually during 10th and 12th days. Later period of tail regeneration is marked by increasing trend of hepatic GOT activity with the control animals showing a very gradual continuous increase which, however, failed to reach the normal level even till 60th day. Both the B and C groups of animals showed a sharp increase by 15th day with the hypothyroidic animals showing a slightly subnormal level and the T4 treated animals marked above normal level. Thereafter, whereas in the B group of animals the enzyme activity continued to remain subnormal, in the T4 replaced animals it fell

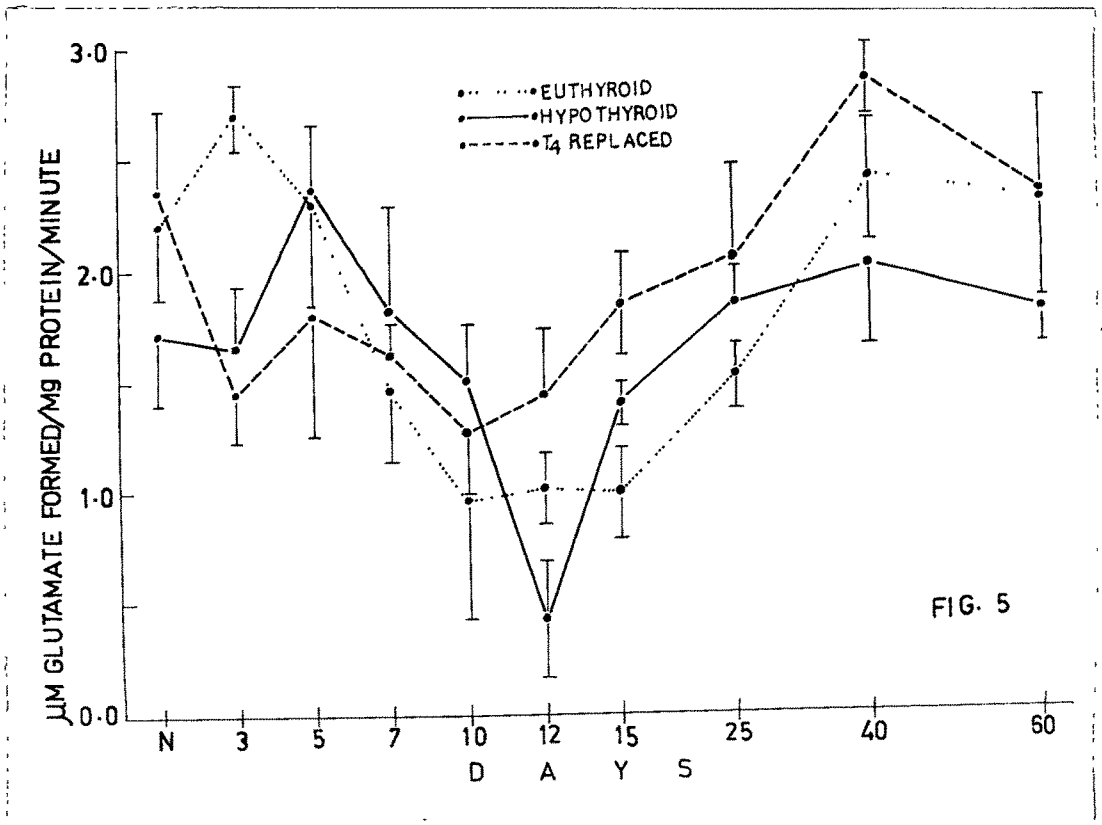

Fig. 5. Changes in glutamate-pyruvate transaminase (GPT) activity in liver during tail regeneration under control euthyroidic, PTU induced hypothyroidic and T4 replaced conditions in M. carinata.

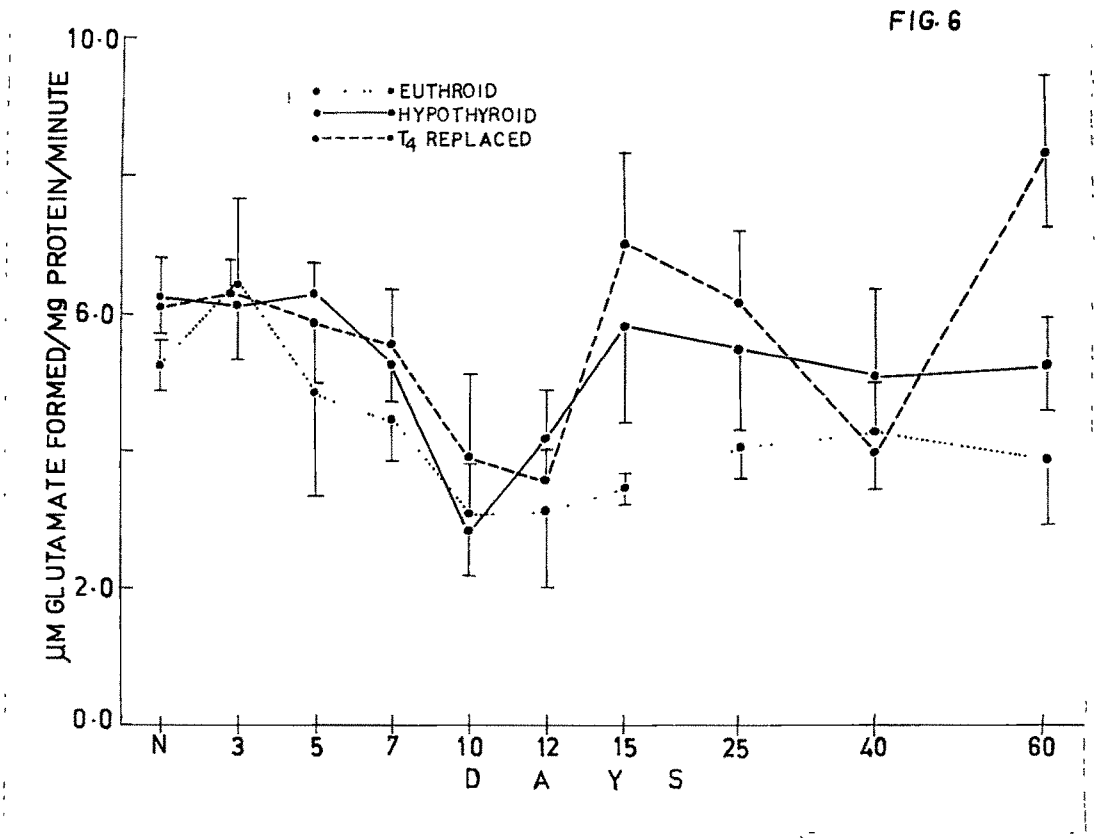

Fig. 6. Changes in glutamate-oxaloacetate transaminase (GOT) activity in liver during tail regeneration under control euthyroidic, PTU induced hypothyroidic and T4 replaced conditions, in M. carinata.

drastically by 40th day and then increased to a very high abovenormal level on 60th day.

Muscle :

Muscle protein content of group A and C animals showed a continuous increase uptill the 10th day. Thereafter, the protein content which remained more or less steady till 15th day in control animals, started declining continuously till a near normal level was attained on 60th day. The T4 replaced group of animals also showed a similar pattern except a slight fall between 10th and 12th days and an increase back to the same level on 15th and 25th days. Contrastingly the PTU treated animals depicted a zig-zag pattern of protein content with above normal levels on 3rd, 10th, 12th and 25th days and below normal levels on 5th, 7th, 15th, 40th and 60th days. Towards the end there was a clear cut trend in the PTU treated animals to maintain significantly declined muscle protein content.

The initial period of tail regeneration lasting upto 7th day post-autotomy was marked by a significantly increasing trend of GPT activity in muscle. By 10th day the enzyme activity dropped considerably to the corresponding near normal levels. Thereafter there was a differential trend of increase in the three groups. Whereas the T4 given animals showed a continuous increase in GPT activity with above normal levels being

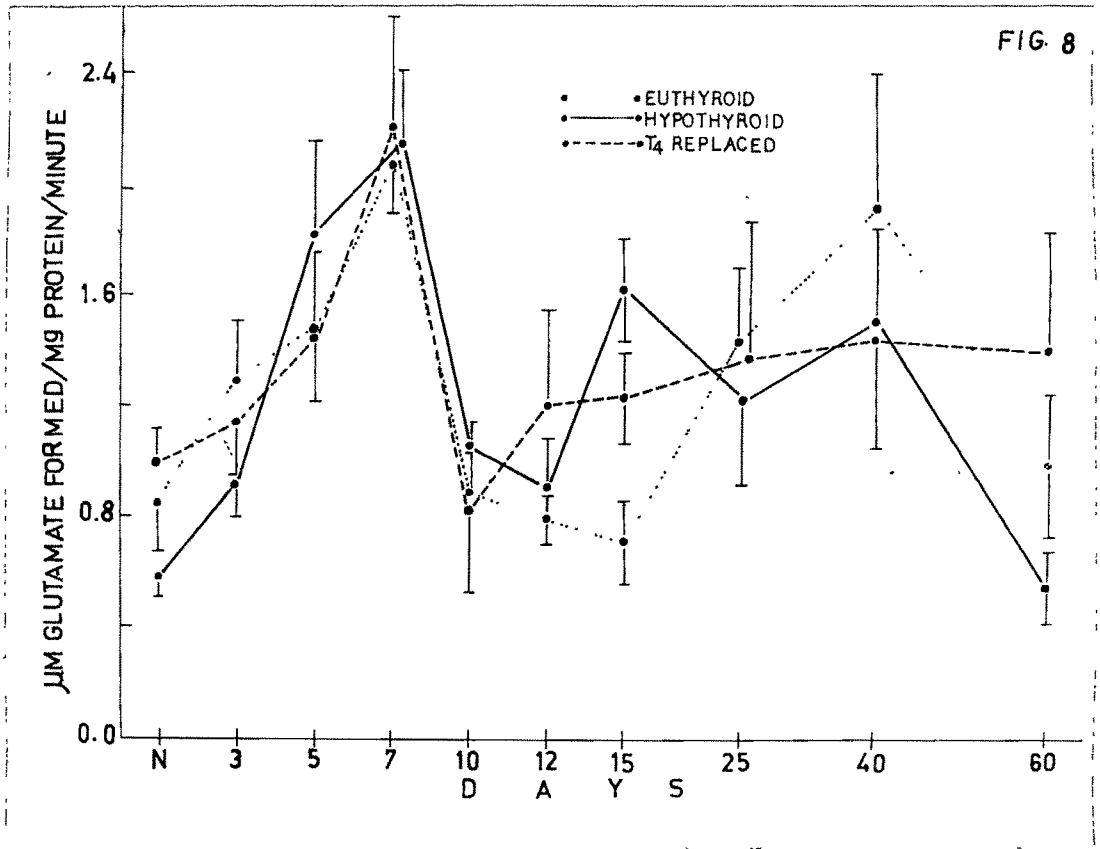

Fig. 8. Changes in glutamate-pyruvate transaminase (GPT) activity in muscle during tail regeneration under control euthyroidic, PTU induced hypothyroidic and T4 replaced conditions in M. carinata.

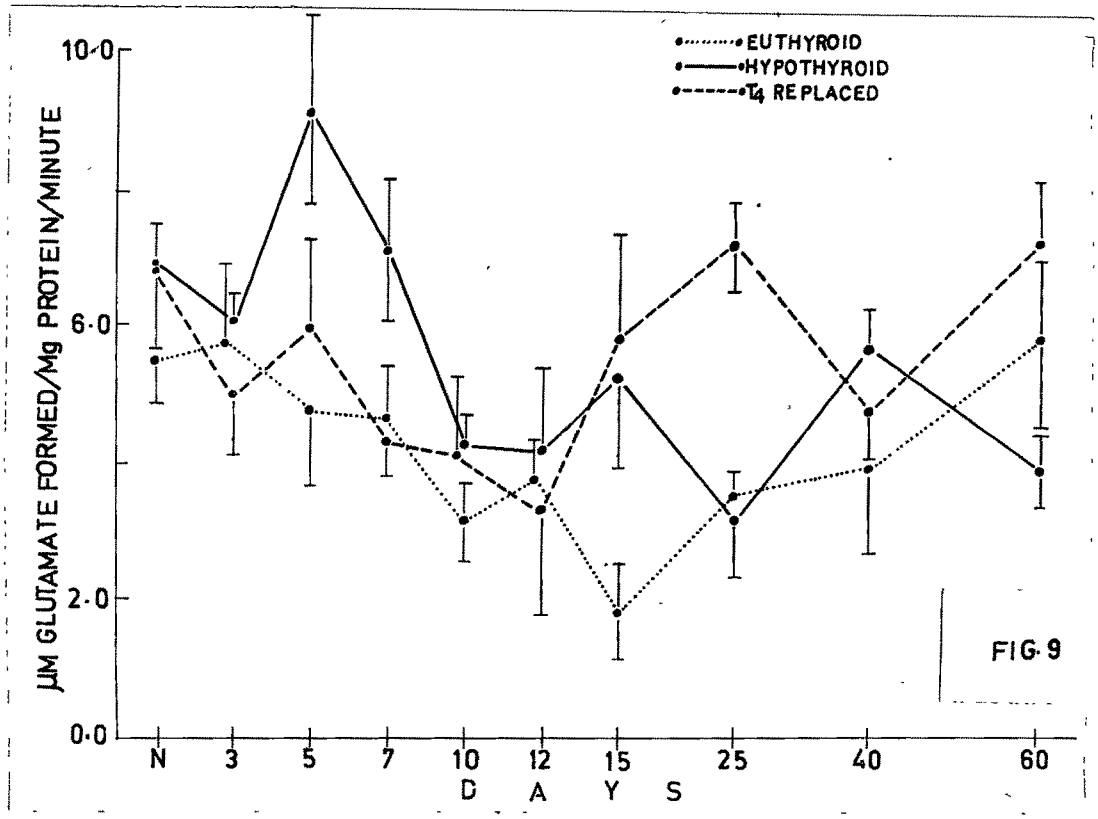

Fig. 9. Changes in glutamate-oxaloacetate transaminase (GOT) activity in muscle during tail regeneration under control euthyroidic, PTU induced hypothyroidic and T4 replaced conditions in M. carinata.

attained from 15th day onwards, in the PTU treated animals the enzyme activity showed a zig-zag pattern between 10th and 40th days of regeneration and then dropped considerably to attain the pre-autotomy level by 60th day. Meanwhile in the control animals, the enzyme activity which was more or less near normal on 10th day showed a slight decline on 12th and 15th days to rise to above normal levels during 25th and 40th days; whereafter the enzyme activity again dropped sharply to the pre-autotomy level by 60th day.

In general, muscle GOT activity showed subnormal levels in all the three groups of animals all throughout regeneration except for an above normal level on 5th day in case of PTU fed animals. In both A and C groups of animals the enzyme activity tended to be decreasing gradually during first 12 to 15 days and increase thereafter with the T4 replaced group of animals being more prominant. In the PTU fed animals though the enzyme activity tended to show a zig-zag pattern once again, it was clearly, however, indicating a linear decrease.

DISCUSSION

Generalised protein anabolism as a feature during regeneration in Mabuya is adequately documented (Ramachandran et al., 1980 b; Chapter V). Coordinate increase in protein content in the liver and skeletal muscle along with the

regenerate is identifiable in the present study too. Abolition of the increase in protein content in all three tissues in PTU fed animals concurrent to inhibition of tail regeneration and its rectification in T4 injected animals simultaneous to occurrence of tail regeneration indicate the involvement of thyroxine in protein metabolism vis-a-vis lizard tail regeneration in a cause-effect relationship. In this context influence of thyroid hormones in protein metabolism of adult tissues of vertebrates is a well recognized fact (Kistler et al., 1975; Saleem and Atkinson, 1979).

Inability of T4 to raise the hepatic protein content to the euthyroidic control levels and thereby showing a close parallelism with the PTU induced hypothyroidic group may represent a common effect to two different causes. This becomes clear in the light of reported decreased hepatic protein catabolism by thiouracil feeding and enhanced catabolism by thyroxine replacement in rats (Yatvin et al., 1964). Clearly then, increase in protein content in the B and C groups of animals is inherent due to inhibited synthesis balanced with reduced catabolism in the former and stimulated synthesis offset with enhanced catabolism in the latter.

GPT and GOT, which are known to bring about inter-conversions between α-ketoglutarate-glutamate, pyruvate-

alanine and oxaloacetate-aspartate by functioning at the junction between protein and carbohydrate metabolism, and, also supply some of these substances for various synthetic reactions, have not been analysed satisfactorily in developing systems. Besides, their relationship with endocrine factors is also poorly understood. Current evaluation of alterations in the activity levels of GPT and GOT during tail regeneration in the regenerate, liver and skeletal muscle under normal euthyroidic, PTU induced hypothyroidic and T4 replaced states enables us to draw following generalisations : (1) Both the transaminases show a similar pattern of tissue specific changes during tail regeneration in all the three experimental groups. (2) GOT activity in all the tissues remains more or less subnormal all throughout regeneration. (3) GPT activity tends to be significantly high in the muscle and regenerate but not in liver during various periods of tail regeneration. (4) Whereas GPT was noted to be higher in all the three tissues under hypothyroidic condition, GOT activity tended to be slightly higher in the T4 administered animals, specifically during the later half of regeneration.

It is apparent that pyruvate-alanine centered metabolic activity does play an important role in meeting the temporal exigencies of regeneration such as protein anabolism, gluconeogenesis, amino acid requirement, etc. Comparatively,

GOT can be presumed to be of less significance in regeneration induced metabolic adaptations in saurians. Present observations also tend to indicate insensitivity of GOT to thyroxine influence in contrast to GPT. More significant percentage increase in GPT activity in all the three tissues in the PTU fed animals in relation to regeneration as compared to A and C groups of animals is probably suggestive of the inhibitory influence of thyroxine on GPT and the absence of this influence in the hypothyroidic B group of animals. Support to this suggestion can be had from the reported inhibition of rat liver GPT by thyroxine in response to cortisone (see Knox and Greengard, 1965). Since GOT activity failed to show a similar response in hypothyroidic animals, it is presumable that GOT is comparatively free of inhibitory influence of thyroxine at least in lacertilians. However, the continued presence of T4 in the system appears to be stimulatory in nature for GOT activity as observed in all the three tissues during the post-blastemic periods of regeneration.

Based on the present observations it may be surmised that under a cortisone influence, muscle and regenerate GPT contribute significantly to the metabolic strategy of lizard tail regeneration. Pertinently, cortisone mediation in tail regeneration as well as significant GPT involvement have already been hinted at (Ramachandran et al., 1980 b and

Chapter V). A tentative inference that emerges from the present observations is the role of thyroxine vis-a-vis transaminase activity. It is obvious that thyroxine has only a permissive influence on transaminase activity while the regulatory control resides in some other endocrine factor/s. The nearly identical modulations in the activity levels of both the transaminases during regeneration in all the three experimental conditions lend credence to this contention and further suggest the involvement of multiple factors and their balanced interactions during reptilian tail regeneration. The significant and coordinate drop in GPT activity observed in liver, skeletal muscle as well as the regenerate on the 12th day in the PTU rendered hypothyroidic animals is a pointer in this direction and indicates the altered equations of the milieu internae in the absence of thyroxine.

On a final note it may be concluded that GPT specifically plays a significant role during tail regeneration in Mabuya carinata and thyroxine performs a permissive act in bringing about optimum modulations of the enzymes.

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