Abstract

Serum levels of T₃, T₄, and TSH hormones, some elements, and glucose with regard to their involvement for growth retardation in yearling rams were investigated. A total of 70 yearling rams of the Akkaraman breed, 50 of which were classified as a retarded growth, and the remaining 20 were classified as normal, were included in the study. Serum total T₃, total T₄, and TSH were measured using chemiluminescent enzyme-labelled immunometric assay with immulite kits. Serum levels of Zn, Cu, and Co were measured using atomic absorption spectrophotometer. Serum glucose was measured using auto analyser. There were significant differences between the yearling rams, with and without retarded growth for serum levels of T₃, Zn, Cu, Co, and glucose. However, there no significant differences for T₄ and TSH between the yearling rams, with and without retarded growth. The results of the study suggest that retarded growth in yearling rams is associated with the lower levels of serum total T₃, Zn, Cu, Co, and glucose; however, there is no scientific evidence for the association of T₄, and TSH in the condition.

Key words: yearling rams, trace elements, retarded growth, thyroid hormones.

Retarded growth in animals concerns the live weight and height of the animal, which is rather lower than the normal values for species concerned. Among the common etiological factors for this condition are, insufficient or imbalanced feeding of the animal, septicemia, chronic infections, parasitism, and hormonal disorders (9, 20).

Trace element deficiencies have been reported to occur in all the geographic regions and climatic zones of the world (26). It is known that particularly mineral and trace element deficiencies, caused by insufficient feeding led to, retarded growth (20). Clinical disorders seen in trace element deficiencies include diarrhea, anaemia, loss of hair, loss of pigmentation, bone deformities, parakeratosis, lack of appetite, reduced fertility, retardation in the development of the foetus, loss of sperm quality, tetany, abortion unrelated to infections, pica, and interruptions in protein synthesis (6, 24, 26).

Zinc is an important element in animal feeding (20), since it plays an important role in the synthesis of hormones. Zinc deficiency results in decline in feed consumption, lack of appetite, and disruptions in synthesis of proteins containing amino acids with sulphur content (12, 30).

Copper deficiency is associated with anaemia, diarrhoea, retarded growth, changes in the colour of fur, fragility of long bones, and even death (8, 20, 28). Deficiencies of zinc and copper negatively affect the endocrine system (24, 26). Furthermore, it has been reported that changes in blood concentrations of various hormones are related to, or influenced by the changes in the levels of many trace elements in urine, blood, and other tissues (1).

Cobalt is a mineral constituent of cobalamin, also known as vitamin B₁₂ (23). Cobalt has been recognised for its role in the formation of red blood cells and maintenance of nerve tissue (11). The element stimulates the growth of the thyroid gland. Importantly, cobalt deficiency is associated with a reduction in type I monodeiodinase activity and T₃ level (23), while excess of cobalt may result in goitre and decreased production of thyroid hormone (2). Common clinical signs in cobalt deficiency, include loss of appetite and subsequent poor growth rate or weight loss, anaemia, scaly ears, and watery discharge from the eyes. Young animals are more susceptible to cobalt deficiency than adults (26).

There is a growing body of evidence that some trace elements (9, 18, 27), thyroid hormones (10, 29), and glucose (13, 16) can influence the growth of animals.

The objective of this study was to determine whether triiodothyronine (T₃), thyroxine (T₄), thyroid
stimulating hormone (TSH), some elements (Zn, Cu, Co), and blood glucose are associated with retarded growth in yearling rams.

**Material and Methods**

A total of 70 yearling rams of the Akkaraman breed were included in the study. On the basis of their body weight, the rams were formed into groups. Fifty rams, 12-months-old and weighing on average 37.30 kg, formed the trial groups, and were considered as the retarded growth group. Another 20 rams, at the age of 12-months, and weighing on average 67.80 kg, were included as a control group. The differences in weights between both groups were statistically significant (P<0.001).

Samples of faeces were collected from all the animals, and examined with native, sedimentation, and flotation methods for the presence of parasites (3). Blood samples were collected from the jugular vein into serum test tubes for measurements of serum trace elements, hormones, and biochemical parameters. The blood samples were collected in the morning between 8 a.m. and 10 a.m., before they were put out to pasturage. Upon the collection, the blood samples were centrifuged at 500 g for 15 min to obtain sera, which were analysed within ten minutes following centrifugation.

Serum total T₃, total T₄, and TSH concentrations were measured by chemiluminescent enzyme-labelled immunometric assay using an Immulite kit (USA). Serum Cu, Zn, and Co levels were measured using atomic absorption spectrophotometer (UNICAM 929, England). Serum glucose was measured using a Technicopera auto analyser.

The data was analysed using an unpaired student t-test. P value <0.05 was considered significant. The data was expressed as the mean ± SEM (standard error of means).

Serum total T₃ levels were significantly lower in the test group compared to those of control group (P<0.01) (Table 1). However, there were no statistically significant differences between the test and control groups for T₄ and TSH levels (P>0.05) (Table 1). Serum glucose level was lower in the test group compared to that of control (P<0.001) (Table 1). Serum Zn, Cu, and Co levels were significantly lower in the test group compared to those of control group (P<0.001, P<0.01, and P<0.01, respectively) (see Table 2).

**Discussion**

Retarded growth is often characterised by a lower body weight and height of the animal concerned. The average live weight in yearling Akkaraman breed sheep, varies between 44.11 and 60.264 kg (7). In the present study, the average live weight of control group was 67.80 kg, which is quite similar to that reported by Colakoglu (7). On the other hand, the average live weight of the rams of the test group was 37.30 kg. This is the apparent feature, for which they were classified as the yearling rams with retarded growth.

**Results**

All yearling rams included in the study, exhibited no skeletal abnormalities or clinical signs of any disease. Neither ecto- nor endo-parasites were detected.

**Table 1**

Mean serum levels of glucose, T₃, T₄, and TSH of control and test groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Glucose (mg/dL)</th>
<th>T₃ (ng/dL)</th>
<th>T₄ (µg/dL)</th>
<th>TSH (µIU/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>77.20 ±2.83</td>
<td>174.8 ±29.06</td>
<td>5.670 ±0.70</td>
<td>0.0064 ±0.0020</td>
</tr>
<tr>
<td>Test</td>
<td>60.20 ±1.83**</td>
<td>96.61 ±5.52*</td>
<td>5.587 ±0.41</td>
<td>0.0029 ±0.0007</td>
</tr>
</tbody>
</table>

* P<0.01; ** P< 0.001; ±SEM

**Table 2**

Mean serum levels of some trace elements in control and test groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>Zn (µg/dL)</th>
<th>Cu (µg/dL)</th>
<th>Co (µg/dL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>74.38 ±0.06</td>
<td>106.50 ±0.042</td>
<td>57.16 ±0.066</td>
</tr>
<tr>
<td>Test</td>
<td>42.24 ±0.04**</td>
<td>93.21 ±0.024*</td>
<td>36.46 ±0.035*</td>
</tr>
</tbody>
</table>

* P<0.01; ** P<0.001; ±SEM
Among the important factors that have great influences on the body growth are trace elements (26, 27), including Zn, Cu, and Co. Besides, the improvement of resistance against diseases they bring on, it has been emphasized in recent years that deficiencies or toxicities due to trace elements cause serious economical losses that are as important as losses due to infections and infestations (6, 24, 26). Zinc is required for cell division and development, and for normal protein synthesis and metabolism, and its deficiency is implemented in the depressed growth and cartilage metabolism in rats (4). Zinc deficiency results in a lack of appetite and growth retardation in lambs (9, 18). Such phenomenon is also supported by the present study, as the serum Zn level was significantly lower in rams with retarded growth (42.24 ±0.04 µg/dL) compared to controls (74.38 ±0.06 µg/dL). The normal serum Zn levels in yearling rams (74.38 ±0.06 µg/dL) is also quite comparable to the blood levels (66.66–117.91 µg/dL) reported in sheep by Nazki and Rattan (19), and the physiologic serum Zn level (80-120 µg/dL) in ewes reported by Bremmer (5).

Copper is also an essential trace element for many biological processes of plants and animals (31). It is also one of the fundamental elements required for growth (27). The present study also suggests that Cu may play a role in the incidence of retarded growth in yearling rams as evidenced by a significant difference between the yearling rams with retarded growth (93.21 ±0.024 µg/dL) and controls (106.50 ±0.042 µg/dL). The normal Cu level in yearling rams (control) is also quite comparable to the value in sheep (106.66 and 201.66 µg/dL), as reported by Nazki and Rattan (19).

The present study also suggests that the Co deficiency is associated with the retarded growth in yearling rams as evidenced by its lower serum level in the yearling ram with retarded growth (36.46 ±0.035 µg/dL) compared to that of control (16 ±0.066 µg/dL). Thus, the present study supports the previous conclusions that the Co deficiency is implemented in aetiopathogenesis of many clinical abnormalities (11, 23, 26). These clinical outcomes due to the Co deficiency are attributed mainly to the fact that Co is an essential trace element for synthesis of vitamin B₁₂ (23).

Among the molecules that have great impacts on metabolism and growth are thyroid hormones. In deficiency, the basal metabolism rate decreases about 30-45% compared to normal values (10, 29). Thrift et al. (25) reported that thyroid hormones can change the nutrient requirements according to the increasing basal energy requirements. On the other hand, feeding regimen may influence levels of thyroid hormone; for instance, Rhind et al. (21) reported that plasma T₃ and T₄ concentrations in Soay sheep fed ad libitum were significantly higher in yearly sheep fed in a limited fashion. Excess and deficiencies in thyroid hormone levels may impact on reproduction and growth performance. Sokkar et al. (22) reported a significant decrease in live weights, fatigue, emaciation, anaemia, and alopecia in buttocks and legs, and oedema of face at the end of their study on lambs with experimental hypothyroidism. Along with these clinical findings, they also found lower T₃ levels. In another study, Kitagawa et al. (14) reported that the total serum T₃ and T₄ concentrations were lower in Black Japanese cattle with lower body weight, but normal appetite as compared with those of normal cattle. Keçeci (15) reported that the postnatal serum thyroid hormone levels were lower in the neonatal lambs with lower body weight at birth than those of lambs with normal weight at birth. The present study also demonstrated that T₃ associated with retarded growth as evidenced by the lower T₃ level in the yearling rams with retarded growth (Table 2). However, the present study did not provide evidence for T₄ and TSH involvement in retarded growth in yearling rams as their levels are not statistically different between the rams with and without retarded growth (P>0.05).

Glucose is the energy source of the organism and its blood level varies among species (13). Blood glucose level in sheep is between 50-80 mg/dL (13, 17). Mert et al. (16) found that cattle with lower blood glucose level gained weight by 3% less than the cattle with normal glucose levels did. In a support this glucose association with lower body weight, the present study provided further evidence as the serum glucose level in the yearling rams with retarded growth (60.20 ±2.83 mg/dL) was lower than that of the control rams (77.20 ±2.83 mg/dL).

We concluded that retarded growth in yearling rams is associated with the lower serum levels of T₃, insulin, Zn, Cu, Co, and glucose. However, there is not enough scientific evidence for involvement of T₄ and TSH in the retardation of growth in yearling rams.

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References