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ROLE OF THE WOOL ANALYSIS IN DIAGNOSIS OF SOME NUTRITIONAL DEFICIENCY DISEASES

(With 4 Tables)

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دور تحليل الصوف فى تشخيص بعض أمراض النقص الغذائى

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شملت الدراسة عدد 40 رأسا من الأغنام تتراوح أعمارها من 2-5 سنوات فى مزرعه خاصة بمحافظة الدقهليه حيث كان من بينها عدد 30 نعجة يظهر عليها أعراض مختلفة منها سقوط الشعر وفقدان الشهية والإسهال. استهدفت هذه الدراسة قياس مستوى بعض العناصر النادره فى مصل وصوف الأغنام الصحيحة والمريضة إكلينيكيا. وقد أظهرت النتائج وجود نقص معنوى فى عناصر كل من الزنك والنحاس والحديد والمنجنيز فى مصل وصوف الأغنام المريضة. كما وجدت زيادة معنوية في عنصر المولبيدنيم فى مصل وصوف نفس الأغنام. وبتحليل علائق الأغنام وجد نقص في مستوى عناصر الزنك والنحاس والحديد والمنجنيز وزياده فى مستوى عنصر المولبيدنيم. وقد أعطت هذه الدراسة النتائج المشجعة في استخدام الصوف كوسيلة لتشخيص أمراض نقص بعض العناصر النادرة في الأغنام.

SUMMARY

This investigation was conducted on 40 ewes (2-5 years) of which 30 ewes showed different diseased conditions including alopecia, anorexia and diarrhoea. Sheep were reared among indoor flock of private farm of Dakahlia province. A study was carried out to detect the alterations in some trace elements levels which may be accompanied with diseased conditions in sheep by analysis of their serum and wool. The results were compared with those obtained from clinically healthy sheep. The study revealed that sheep suffered from diseased conditions (alopecia, anorexia and diarrhoea) showed highly significant decrease in the serum and wool zinc, copper, iron and manganese levels in comparison with clinically healthy ones. On the other hand, a highly significant increase was observed in serum and wool molybdenum level of these sheep. The diet analysis, showed low concentrations of zinc, copper, iron and manganese and high molybdenum concentration in comparison with normal concentration recorded by (NRC 2005). These findings indicated that the concentrations of trace elements in the wool of sheep gave a good indication for the diagnosis of its nutritional deficiency diseases.

Key words: *Trace elements diagnosis, wool analysis, serum analysis.*

INTRODUCTION

Analysis of wool and hair can be used now for the detection of some nutritional deficiencies or poisoning. It has been proposed that body stores of minerals may be estimated from hair or wool analysis, because growing hair is metabolically active and is a sequestering tissue. Thus, hair may reflect concentrations of minerals that were in the hair follicle at the time the hair was formed (Combs *et al.,* 1982). Serum or plasma levels of trace elements had long been used for the determination of the minerals status of the animals and diagnosis of their deficiency diseases. In recent years, several efforts by a number of laboratories have been directed toward the use of hair or wool analysis as a diagnostic aid in determining the trace mineral status in man and animals. Trace elements are accumulated in wool at concentration that are at least 10 times higher than those present in the blood, serum and urine (Maugh, 1978). Among the trace elements, zinc, copper, iron and manganese were known to be dietary and metabolic essential elements, they control numerous enzymatic and metabolic function (Shalaby, 2003). Wool is a very easy biological material to collect and is stable for copper estimation; wool copper levels played a great role as an aid in diagnosis and detection of copper deficiency (Kellaway *et al.,* 1978). The level of some trace elements including copper, zinc, iron and manganese in wool samples was considered as effective tool to detect nutritional deficiency. Besides, wool analysis is easier, unexpensive, safe and reliable (Fahmy *et al.,* 1980). Coat and skin affections in domestic ruminants seemed to influenced by dietary intake of some important trace elements (Fahmy *et al.,* 1980). Copper deficiency in sheep is often associated with wool abnormalities including loss of crimp, steely appearance, depigmentation and impaired keratinization (Saleh *et al.,* 1998). McDowell *et al.* (1991) reported that anorexia, parakeratosis, alopecia, cessation of wool growth, unthriftness and pale mucous membrane were the most common clinical signs of zinc deficiency in sheep.

This study was conducted to clarify the relation between some clinical symptoms (alopecia, anorexia and diarrhoea) and levels of zinc, copper, iron, manganese and molybdenum in serum and wool of sheep. Also the use of wool as a material for diagnosis of the deficiencies of these trace elements.

MATERIALS and METHODS

A- Animals:

This investigation was conducted on 40 ewes (2-5years old) of which 30 suffered from some clinical symptoms, including alopecia (15), anorexia (7) and diarrhoea (8), with growth retardation, loss of skin rigidity and elasticity. Also a wool abnormality was observed, including loss of crimp, steely appearance and depigmentation in all investigated animals. The other 10 ewes have served as control and were healthy depending upon clinical and laboratory examinations (by analysis of serum, wool and faecal samples). Sheep were reared among indoor flock of the private farm of Dakahlia province. Commercial concentrate ration (Contained 40% cotton seed cake, 20% wheat bran, 20% yellow corn, 10% lime stone and 1% common salt) at rate of 250 gm / head / daily was offered to the ewes.

Also rice straw was administered ad. Lib. No feed additives were supplied. The ewes were freely watered.

B - Samples and adopted methods:

1- Whole blood:

Whole blood samples without anticoagulant were collected from all clinically healthy and diseased sheep for determination of serum levels of zinc, copper, iron, manganese and molybdenum (ug/dI) by using Atomic Absorption Spectrophotometer (Perkin Elmer, Model 3110, Made in USA) according to the method adopted by Chapmaa and Pratt (1978).

2- Wool and feed samples:

Wool samples were collected from both healthy (10 samples) and diseased (30 samples) ewes, while feed samples was taken from the farm about 2 kg from commercial concentrate and rice straw. The samples mixed well and subsamples in amount of 500gm were dried in hot – air oven at 105^0c for 5hours then kept in dry condition in paper bags. About 2gm from each sample was ashed at 550^0c for 24 hrs, then proceeded for detection of zinc, copper, iron, manganese and molybdenum in wool and feed using Atomic Absorption Spectrophotometer using wet digestion (sulfuric acid and perchloric acid) according to the method described by Peterburg Ski (1968).

3- Skin scrapping:

Skin scrapping samples were taken from the body surface of diseased animals (30samples) for examination of dermatophytes and metazoan parasite according to the method described by Coles (1986).

4- Faecal samples:

Faecal samples were taken from both healthy and diseased ewes (40 samples) then examined parasitologically according to the method described by Coles (1986).

5- Statistical analysis:

The obtained data were statistically analyses by the method of Snedecor and Cochran (1982).

RESULTS

A - Physical examination:

The clinically diseased ewes have been reported to suffer from poor growth, alopecia, anorexia, unthriftness and diarrhoea. The skin became dry, scaly and thick and may encrusted, creaking and fissures. The wool was loose and easily detached, also loss of crimp, steely appearance and depigmentation. All affected animals showed pale mucous membranes and rapid pulse rate. Body temperature and respiratory rate were within normal.

B - Laboratory findings:

The results of serum, wool and feed biochemical analysis are presented in Tables 1 , 2 & 3 respectively.

Neither faecal examination, nor skin scraping revealed parasitic or mycotic skin infection of the investigated animals.

Table 1: Mean levels of trace elements in sera of clinically healthy and diseased sheep. (ug/dI)

Items / Elements	Control healthy ewes n =10	Diseased conditions		
		Alopecia n =15	Anorexia n = 7	Diarrhoea n = 8
Zinc	101.96±1.86	59.30±3.96***	56.92±2.12***	65.67±1.86***
Copper	119.82±4.71	72.42±4.11***	78.64±3.12***	96.06±6.49***
Iron	163.46±4.10	98.08±4.43***	95.31±2.97***	101.35±4.66***
Manganese	36.50±1.86	13.31±1.31***	19.66±1.80***	21.23±1.84***
molybdenum	4.32±0.18	6.65±0.23***	6.15±0.34***	6.18±0.31***

*** very highly significant (P≤ 0.001)   n = number of the animals

Table 2: Mean levels of trace elements in wool of clinically healthy and diseased sheep. (ppm)

Items / Elements	Control healthy ewes n = 10	Diseased conditions		
		Alopecia n = 15	Anorexia n = 7	Diarrhoea n = 8
Zinc	123.83±3.36	68.43±2.14***	91.11±4.42***	99.21±4.04***
Copper	80.53±3.21	52.51±3.04***	46.78±3.06***	59.75±3.20**
Iron	165.59±4.60	83.76±2.90***	75.08±3.28***	144.18±5.95*
Manganese	35.92±1.97	12.85±0.87***	15.84±0.92***	27.09±1.99*
molybdenum	9.15±0.58	16.10±0.85***	12.5±0.66**	13.32±0.52***

* Significant ($P \leq 0.005$) ** highly significant ($P \leq 0.01$)
*** very highly significant ($P \leq 0.001$) n = number of the animals

Table 3: Comparative percentage (%) of some trace elements in sera and wool of sheep with different diseased conditions:

Items / Elements	Diseased conditions					
	Alopecia n = 15		Anorexia n = 7		Diarrhoea n = 8	
	serum	wool	serum	wool	serum	Wool
Zinc	48.17	44.74	45.23	26.42	35.59	19.88
Copper	39.56	34.79	34.37	41.91	19.83	25.80
Iron	40.0	49.42	41.69	54.66	38.00	12.93
Manganese	63.53	64.23	46.14	55.90	41.84	24.58
molybdenum	53.90*	75.96*	42.36*	36.61*	43.06*	45.57*

Exceptionally * = increase percentage n = number of the animals

Table 4: Estimated values of trace elements concentrations in the diet of diseased sheep: (ppm)

Elements / items	Zinc	Copper	Iron	Manganese	Molybdenum
Commercial concentration	40.6	11.9	168.2	35.5	8.70
Rice straw	2.8	1.9	72.4	78.7	8.20
Total available	43.4	13.8	240.6	114.2	16.90
Normal conc. (control)*	60	20	300	200	Less than 3

*according to (NRC, 2005)

DISCUSSION

Modern aspects in veterinary practice are now directed towards increasing meat production by improvement of growth rate, efficiency of food utilization and reproductivity with a minimal and cheapest cost of food intake via perfect nourishing and combating diseases.

The clinical symptoms recorded in the present study aroused suspicion of trace elements deficiency in the diseased sheep and were coincided with those previously described by (Fahmy *et al.*, 1980; Eassa, 1987; McDowell *et al.*, 1991; Radostits *et al.*, 2000; Faris, 2002).

Analysis of feed samples revealed that the contents of zinc, copper, iron and manganese were at the marginal limits when compared with the results of (Eassa, 1987; Abo Zana, 1996; Faris, 2002). On the other hand, molybdenum content of the ration in this work was high (16.90 ppm) and this was in agreement with the results of (Radostits *et al.*, 2000), who mentioned that diets contain 4-24 ppm molybdenium are considered high. While pastures containing less than 3 ppm (D.M.) of molybdenum are considered to be safe and clinical signs may occur at 3-10 ppm, if the copper intake was low.

The obtained results indicated that zinc level in both serum and wool of sheep with alopecia, anorexia and diarrhoea was highly significant ($p<0.001$) decreased as compared with the control group. This result may be attributed to nutritional deficiency of zinc which confirmed by analysis of ration. This observation was in agreement with those mentioned by (Fahmy *et al.,* 1980; Eassa, 1987; Faris, 2002). While El-Sayed *et al.* (1999) recorded that zinc was a constituent of several important enzymes, played an indispensable role in many metabolic process in the body, its deficiency decreased efficiency of feed utilization and impairment of the animal health. There was a general relationship between zinc content of the hair and its level in the diet (Radostits *et al.,* 2000). On the other hand, Jones *et al.* (1997) mentioned that higher dietary calcium in the presence of phytic acid reduces zinc absorption.

The diseased sheep in the present study were suffered from hypocupraemia as proved from the results of serum and wool analysis. These results confirmed the findings of (Fahmy *et al.*, 1980; Eassa, 1987, Saleh *et al.,* 1998; Faris, 2002). The decrease in the serum copper could be attributed to inadequate copper in the diet or due to other factors which reduce the availability of dietary copper in the rumen (El-Sayed and Hassan, 1993). Moreover Suttle, (1991) recorded that the interaction between copper, molybdenum and sulfur in ruminant nutrition could be combined in the rumen to form an unabsorpable triple complex (copper tetrathiomolybdates) and reduction copper of host tissues. Radostits *et al.* (2000) published that the reduction of serum copper level might be attributed to secondary copper deficiency like dietary excess of elements e.g. (molybdenum, inorganic sulfate, zinc, iron and calcium carbonate). Moreover, Copper deficiency caused achrmotrichia or lack of pigmentation of wool because it essential for the synthesis of tyrosinase enzyme which is involved in the conversion of tyrosine to melanin (Radostits *et al.,* 2000). Also the wool losses its crimp and become steely, the fact that steely wool has more sulphahydryl groups (SH) and fewer disulphide group (S-S) suggests that copper is required for the oxidation of SH to S-S groups in keratin synthesis (McDonald *et al.*, 1985).

The reduction of the serum and wool iron level in this study might be attributed to the deficiency of iron in the diet or due to copper deficiency, which decreases the absorption of iron and releases the iron from the body stores in addition to the utilization of iron in haemoglobin synthesis. Similar data were recorded by (Nasser, 1995; Faris, 2002; Shalaby, 2003).

The reduction of serum and wool manganese level in diseased sheep in this study may be attributed to a dietary deficiency of manganese. Binot *et al.* (1968) reported that manganese level in wool can be used as indicators of their status in the body. While Radostits *et al.* (2000) recorded that manganese level in hair was reflected the manganese dietary supply better than any other part of the body. Moreover, Underwood, (1982) mentioned that the manganese deficiency inhibits growth through reduction in feed consumption and impaired efficiency of feed utilization.

A highly significant increase was found in serum and wool molybdenum level in diseased sheep when compared with clinical healthy ones. Similar results were previously obtained by (Fahmy *et al.*, 1980; Mohga, 2000; Faris, 2002). Such elevation can be explained by the antagonist relationship between copper and molybdenum which was previously described by Suttle (1991).

These findings indicated that the concentrations of zinc, copper, iron, manganese and molybdenum in the wool of clinically diseased sheep gave a good indication for the diagnosis of the nutritional deficiency diseases of these trace elements. Wool samples can be used to detect the trace minerals deficiencies before the appearance of the clinical symptoms.

Recommendation for prevention the nutritional deficiency diseases by regular analysis of the wool sample for important trace elements

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