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Studies on nutritional deficiency in caws in El-Behera province

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A B S T R A C T

Thirty eight mixed breed cows, 3-7 years old suffered from alopecia (34%), ill-thrift (50%) and infertility (16%) and seven apparently healthy cows were selected from different villages at El-Behera province in autumn 2018. All cows were subjected to clinical and laboratory examination. Poor appetite, reduced milk production and pale conjunctival mucous membranes were recorded in diseased cows. Rough and shed coat and brownish discoloration of black hair were observed in some cows. Decreased ruminal motility, poor performance, anestrum, delayed estrus and repeat breeding were also diagnosed. Gray-blackish, semisolid-pasty feces, containing undigestible food fibers are common. Mild-moderate nematode (83%), *Fasciola* (15%) and *Paramphistoma* (2%) eggs were recorded. Serum biochemical results showed significant decrease in the mean values of copper, zinc, calcium, inorganic phosphorus and magnesium in cows with alopecia, ill-thrift and infertility. Hematological studies showed significant decrease of RBCs, Hb, PCV, MCV and MCH in all diseased cows. Moderate microcytic, hypochromic anemia is recorded.

Keywords: Cows; Nutrient elements; Ill-thrift; Alopecia; Infertility

1. Introduction

Copper, zinc, and certain macro-elements like calcium, phosphorus and magnesium have been found to be very essential for normal livestock growth (Karn, 2001; Oetzel, 2013). Copper and zinc have great roles in body metabolism and immune system function as cofactors for some metalloenzymes which make them vital for cattle (Tomaszewska et al., 2016).

A primary copper deficiency in cows' causes ill-thrift, decreased milk production, anemia, and rough coat and discolored its color, decreased conception rates and depressed immunity. Hoof problems and diarrhea in some cases (Philip et al., 2011; Constable et al., 2017).

Zinc is important trace element that is metabolically active as prosthetic groups in over 300 different enzyme systems required for animal health and productivity (Wilkinson et al., 2008). It has been shown to play an essential role in many cow reproductive functions such as strong estrus cycles, improved conception rates, promotion of normal post-partum uterine involution, and reduction of metritis (Vitti, 2018). A primary zinc deficiency resulting from low dietary zinc in ruminants is rare but does occur when soil pH rises above 6.5 and as fertilization with nitrogen and phosphorus increases (Constable et al., 2017).

Adequate blood calcium, phosphorus and magnesium concentrations are vital to normal function of dairy cows. Less severe disturbances in blood concentrations of these minerals can cause reduced feed intake, poor ruminal and intestinal motility, poor productivity, reduced immune function, and increased susceptibility to other metabolic and infectious disease (Smith, 2015). The present study aimed to focus on some disorders and their relation to nutritional deficiency in cows at El-Behera province with regard to clinical signs, fecal analysis as well as hematological and serum biochemical parameters.

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2. Material and methods

2.1. Animals and experimental design

Forty five mixed cows with age ranged from three to seven years old were selected from different villages at El-Behera province in autumn 2018. The animals are divided into two groups according to clinical and laboratory examinations. The first group includes seven healthy cows (control group), while the second one includes thirty eight cows which suffered from alopecia (13 cows), ill-thriftiness (19 cows) and infertility (6 cows). Body temperature, pulse and respiration rates, and character of conjunctival mucous membranes, auscultation of chest and abdomen as well as general health condition were recorded (Rosenberger, 1979).

2.2. Fecal Examination

Fecal samples were collected directly from the rectum of each cow and examined as soon as possible macroscopically for consistency, color, and detection of undigested food particles, mucus, and blood. Also the feces were prepared by sedimentation and flotation technique and examined microscopically for detection of any parasitic ova (Kelly, 1984).

2.3. Hematological and biochemical analysis

Serum levels of calcium (Moorehead and Briggs, 1974), inorganic phosphorus (Weissman and Pileggi, 1974), magnesium (Farrell and Kaplan, 1984), copper (Abe et al., 1989) and zinc (Johnsen and Eliasson, 1987) were determined using commercial test kits according to the manufacturer's protocol and carried out with a UV spectrophotometer colometrically. Also, complete blood picture was performed (Jain, 2000).

2.4. Statistical analysis

Statistical analysis was performed using (SPSS, 2001) software package, version 13. The values was analyzed by one-way analysis of variance (ANOVA), followed by Duncans's multiple range test. All results were expressed as means ± SE (standard error), $P<0.05$ is significant.

3. Results

Rectal temperature, pulse and respiratory rates of diseased cows ranged from 38.0-38.5^{O}C, 62-87, and 18-35, respectively. Loss of appetite, reduced milk production, and pale conjunctival mucous membrane were observed in most cows (Fig. 2). Rough, shed coat and brownish discoloration of black hair in some cows (Fig. 3). Decreased ruminal motility, ill-thrift and arched back in other ones (Fig. 4). Repeat breeding (Fig. 5), anestrum, delayed estrus were recorded. Fecal samples were characterized by gray-blackish in color, semisolid-pasty in consistency, offensive in some cases, containing undigestible food fibers. Mild-moderate nematode (83%), *Fsciola* (15%) and *Paramphistoma* (2%) eggs were obtained.

The results of nutrient elements values in the blood serum (Table 1 and Fig. 1) and hematological findings (Table 2) of healthy and diseased cows were recorded.

4. Discussion

Several studies have investigated nutrient elements deficiency in dairy cattle. Copper, zinc, calcium, phosphorus and magnesium deficiencies have been observed and studied in thirty eight cows selected from different villages at El-Behera province in autumn 2018.

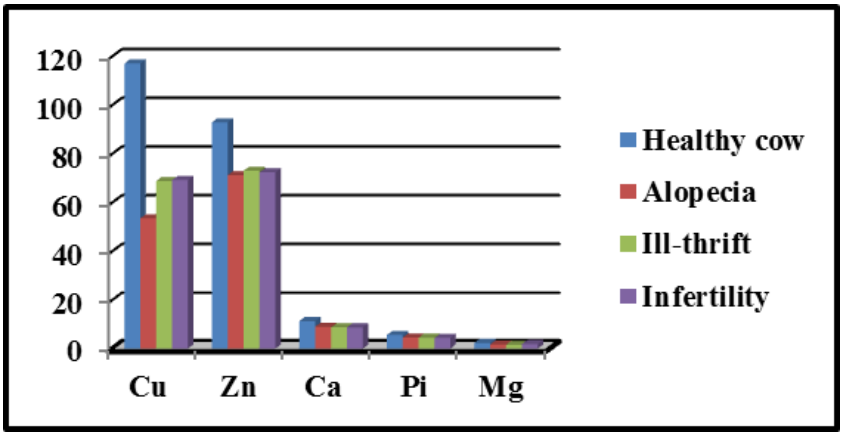

Figure 1: Nutrient element values in serum of healthy and diseased cows

Table 1: Nutrient elements values in serum of healthy and diseased cows

Parameters	Unit	Healthy cow N:7	Alopecia N:13	Unthrifty N:19	Infertility N:6
Copper	ug/dl	110 – 126	44 -75	65 – 88	60 – 90
		117±2.13[a]	53.46±3.35[c]	68.75±2.26[b]	69.17±4.36[b]
Zinc	ug/dl	85 – 105	64 – 78	68 – 80	60 – 85
		92.86±3.25[a]	71.15±1.36[b]	73±0.93[b]	72.33±3.47[b]
Calcium	mg/dl	10.9 - 11.7	8.4 - 9.55	7.75 - 9.60	7.7 – 9.8
		11.27±0.13[a]	8.98±0.13[b]	8.76±0.12[b]	8.71±0.31[b]
Inorganic phosphorus	mg/dl	5.1 - 5.9	4.15 – 4.8	4.21 – 4.68	4.3 – 4.7
		5.57±0.14[a]	4.5±0.06[b]	4.46±0.04[b]	4.33±0.2[b]
Magnesium	mg/dl	2.37 - 2.55	1.62 - 2.28	1.7 - 2.20	1.2 - 2.35
		2.33±0.05[a]	1.63±0.09[b]	1.56±0.07[b]	1.87±0.2[b]

Values are means ± SE; means with different super scripts in the same raw are significantly different at the level P≤0.05 and P≤0.01

Table 2: Hematological values of healthy and diseased cows

Parameters	Unit	Healthy cow N:7	Alopecia N:13	Ill-thrifty N:19	Infertility N:6
RBCs	$\times 10^6/\mu L$	5.02 - 5.35	3.75 - 4.12	3.85 – 4.4	3.9 – 4.2
		5.22±0.05[a]	3.91±0.02[b]	3.92±0.03[b]	3.96±0.05[b]
Hb	g/dL	12.9 - 13.5	7.5 – 9.4	7.8 – 9.9	8.2 – 9.6
		13.07±0.07[a]	8.02±0.17[c]	8.39±0.17[c]	8.98±0.16[b]
PCV	%	33 – 45	22.9 – 31	27 – 33	24.5 - 31.8
		41.49±1.68[a]	25.04±0.66[c]	28.14±0.34[b]	28.4±0.96[b]
MCV	fL	78.5 - 85.9	35 – 59	37 – 63	43 – 60
		82.54±1.37[a]	46.46±2.57[b]	49.25±1.95[b]	46.5±3.34[b]
MCH	Pg	25.7 - 27.5	12.3 - 18.8	13.5 - 19.5	14 - 18.7
		27.0±0.23[a]	16.34±0.71[b]	16.39±0.47[b]	15.78±0.75[b]
MCHC	g/dL	31.8 - 34.6	30.5 - 35.3	30.9 – 35	31.7 - 35.8
		32.71±0.37[a]	32.49±0.49[a]	32.54±0.34[a]	32.93±0.61[a]

Values are means ± SE; means with different super scripts in the same raw are significantly different at the level P≤0.05 and P≤0.01

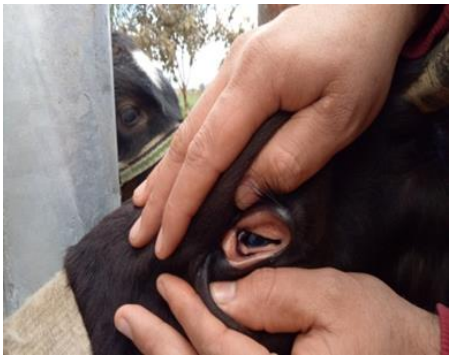

Figure 2: Cow with pale conjunctival mucous membrane.

Figure 3: Cow with alopecia in abdomen and brownish discoloration of black hair.

Figure 4: Cow with ill-thrift, shed coat hair, and arched back.

Figure 5: Cow with ill-thrift and history of repeat breeding.

Copper and zinc status was assessed by serum copper and zinc analysis. Significant decrease in the mean values of serum copper in cows with alopecia ($p<0.01$), ill-thrift and infertility ($p<0.05$) were recorded. Enjalbert, et al. (2006) mentioned that copper deficiency did not increase the risk of low fertility or other reproduction disorders. Poor fertility can be due to a lot of nutritional imbalances, particularly energy deficiency in dairy cows (Jorritsma et al., 2003). Kendall et al., (2003) suggests that infertility is more largely related to secondary copper deficiencies due to excess molybdenum than to primary copper deficiency. Also, the infertility seen with secondary copper deficiency may be due to excess circulating oxy-thiomolybdates which interfere with the release of luteinizing hormone (Maas, 2009). The deficiency of minerals such as, calcium, phosphorus, zinc and copper have been reported to be a predisposing factor for the occurrence of repeat breeding in dairy cows (Sheetal et al., 2014; Kumar, 2014). Phosphorus has been most commonly associated with decreased reproductive performance in dairy cows including inactive ovaries, low conception rates, repeat breeding and poor conception rate were recorded by Satish Kumar (2003). Our studies showed that 13 cows (34 %) affected with rough, shed coat and brownish discoloration of black hair. This coincided with those reported by Underwood and Suttle (1999) and Constable et al., (2017). Copper acts as component of metalloenzymes which involved in multiple physiological processes including respiration, carbohydrate and lipid metabolism, antioxidant activities, and collagen formation (Andrieu, 2008; NRC, 2001; Tomlinson et al., 2004). Copper is also a component of polyphenyl oxidase which catalyses the conversion of tyrosine to melanin and incorporation of sulfide group into keratin in the hair (Underwood and Suttle, 2001). Zinc, similar to copper, is required for normal keratinization of fibers (Hynd, 2001). Hair loss and rough coat is a known effect of zinc deficiency in cattle (Constable et al., 2017).

Reduced milk production, poor performance, ill-thrift are the main owner complains in our study. Significant decreased ($p<0.05$) in the mean values of serum zinc in all diseased cows were obtained. Reduced milk production is probably related to loss of appetite, which is the earliest clinical sign of zinc deficiency (Hill and Shannon, 2019). Also, lack of appetite and low feed efficiency increased risk of poor performance and ill-thrift (Engle et al., 1997).

Parasitic gastroenteritis caused by gastrointestinal nematodes continues to be a major constraint against profitable cow health and production. Deficiencies of copper and zinc in the blood serum have been associated with gastrointestinal nematodes infection (Kristine, 2003). Adogwa et al. (2005) and Suarez (2019) mention that gastrointestinal nematodiasis significantly aggravated an existing copper deficiency. The presence of Fasciola hepatica in the body of cattle significantly reduces the level of copper and zinc, with a high inverse correlation dependence on the intensity of infection (Kruchynenko et al., 2018).

Significant decreased ($p<0.05$) in the mean values of serum calcium, inorganic phosphorus and magnesium in cows with alopecia, ill-thrift and infertility were recorded. A large proportion of dairy cows undergo a period of hypocalcemia with the onset of colostrogenesis and lactation. Subclinical and clinical hypocalcemia have subsequent impaired health and productive and reproductive performance of dairy cows (Vieira-Neto et al., 2017; Wankhade et al., 2017). Phosphorus deficiency also is common in dairy cows. It has been most commonly associated with decreased reproductive performance (Jaswinder Singh, 2018) and body weight (Mokolopi, 2019). Hypomagnesemia is a common problem in ruminants and is often accompanied by and complicated by hypocalcemia. Moderate hypomagnesemia is associated with reduced feed intake, nervousness, and reduced milk production (Smith, 2015).

Significant decrease ($p<0.05$) in the mean values of RBCs counts in all diseased cows and significant decreased in the mean values of hemoglobin in cows with alopecia and ill-thrift ($p<0.01$) and infertility ($p<0.05$) were obtained. Copper plays an important role in iron transport from the gut to the marrow, and in the incorporation of iron into the hemmoiety. The anemia produced by copper deficiency is generally moderate, slowly progressive, and closely resembles iron deficiency in that it is usually a microcytic, hypochromic anemia (Smith, 2015). MCV and MCH are significantly decreased ($p<0.05$) in all diseased groups. Jones and Allison (2007) and Roland et al. (2014), noted that MCV is reduced in copper deficiency, which indicates microcytic anemia. Mazzullo et al. (2014) mentioned that the reduction of hemoglobin may be an early indicator of iron deficiency, as this index decreases faster than MCV and MCHC in microcytic anemia. Literature data provide little information concerning hematological changes in zinc deficiency in cattle.

In conclusion, a considerable correlation between copper, zinc, calcium, inorganic phosphorous and magnesium levels in the blood of dairy cows and the general health status, coat health, fertility and productivity was established.

Competing interest

No conflict of interests

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