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Bovine Liver Abscesses Pus and the Status of Some Important Minerals

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Abstract: This research was conducted to determine selenium, copper, zinc, iron, calcium, phosphorous and magnesium concentration in the pus of cow liver abscess. The liver has a large reserve of function and approximately three-quarters of its parenchyma must be rendered inactive before clinical signs of hepatic dysfunction appear. Local suppurative infections of the liver cause significant losses in feedlot and grain-fed cattle because of the frequency of rumenitis in those cattle leading to hepatic abscess formation. Also we know some minerals that can alter and uphold the specific immunity. At the presence of adequate amount of zinc, the formation of hepatic abscess may reduce. For this reason and to determine the mineral concentration in pus, the present study was designed on 40 slaughtered cattle with liver abscess in Shahrekord district. For measuring the minerals concentration, Potentiometric Stripping Analyzer (PSA), atomic absorption spectrometry were used. Results showed that the concentration of Se, Zn, Fe, Cu, Ca, P and Mg in pus were 0.551 Â±0.046 (mg kg^{-1}), 6.41Â±2.32 (mg kg^{-1}), 18.18Â±14.03 (mg kg^{-1}), 6.63Â±4.83 (mg kg^{-1}), 221.8Â±85.82 (mg kg^{-1}), 0.85Â±0.32 (g kg^{-1}) and 40.64Â±21.72 (mg kg^{-1}), respectively. The concentration of mentioned minerals in liver parenchyma's were determined 1.06Â±0.15 (mg kg^{-1}), 82.91Â±32.22 (mg kg^{-1}), 62.29Â±22.12 (mg kg^{-1}), 39.22Â±28.17 (mg kg^{-1}), 0.12Â±0.04 (g kg^{-1}), 1.81Â±0.56 (g kg^{-1}) and 0.15Â±0.07 (g kg^{-1}), respectively. For determining the correlation between mineral concentration in pus and liver parenchyma, Pearson correlation was used at The level of $p<0.05$. The correlation between pus Fe and Cu and also Ca and Se were significantly positive (pvalue = 0.000228, r = +0.871) and negative (pvalue = 0.0305, r = -0.623), respectively. In liver parenchyma the correlation between Zn and Ca (pvalue = 0.0487, r = 0.535) and also Fe and Cu (pvalue = 0.0317, r = +0.596) were significantly positive.

Key words: Minerals, liver, pus, cattle, slaughter house

INTRODUCTION

Liver abscess can occur at all ages and in all types of cattle, including dairy cows, but they have the greatest economic importance for grain-fed cattle (Nagaraja and Chengappa, 1998; Bryant *et al*., 2004). The incidence of liver abscesses in specific groups of grain-fed cattle can range from 1 to 2% to as high as 90 or 95%. Generally, the incidence averages from 12 to 32% in most feedlots (Brink *et al*., 1990). The distribution of abscesses in the liver lobes shows no consistent pattern. Abscesses are composed of pyogranulomatous reaction with necrotic centers composed of degenerating hepatocytes and leukocytes (Brink *et al*., 1990). On the other hand, several lines of evidence suggest that modification of zinc and/or iron concentrations in pus may suppress bacterial growth and secondarily suppress microbial susceptibility to antibiotics (Bryant *et al*., 2004). Copper, zinc and selenium deficiency alters immune response in humans and animals (Howard and Smith, 1999; Geoffrey and Arthur, 2005). Due to these respects and to determine selenium, copper, zinc, iron, calcium, phosphorous and magnesium concentration in the pus of liver abscess, this research was conducted in Shahrekord slaughter house.

MATERIALS AND METHODS

This research was carried out on 40 slaughtered cattle from March to September, 2007 in Shahrekord (Iran) that suffered from liver abscesses. Pus and liver parenchyma samples were taken after slaughtering of affected cattle. At laboratory, pus sediment was separated by centrifugation at 10000 g for 10 min. For measuring of zinc and copper concentrations, Potentiometric Stripping

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Analyzer (PSA) and for selenium, iron, calcium, phosphorous and magnesium values, atomic absorption spectroscopy (AAS; Perkin-Elmer, 1981a and b) were used, respectively. Data's reported as Mean Â±SE and for determining the relationship between minerals concentration in pus and liver parenchyma the Pearson Correlation (Sigma Stat, Jandel Sci, San Rafaael, CA) was used at the level of $p<0.05$.

RESULTS

The main objectives of present research were to determine the concentration of minerals including Se, Cu, Zn, Fe, Ca, P and Mg and determining the correlation between values in pus and liver tissue. The concentration of all mentioned minerals in pus were lower than liver parenchyma, except for calcium (Table 1). The concentrations of mentioned minerals in liver parenchyma's were also determined. The correlation between pus Fe and Cu and also Ca and Se were significantly positive (pvalue = 0.000228, r = +0.871) and negative (pvalue = 0.0305, r = -0.623), respectively (Table 2). In liver parenchyma the correlation between Zn and Ca (pvalue = 0.0487, r = +0.535) and also Fe and Cu (pvalue = 0.0317, r = +0.596) were significantly positive.

DISCUSSION

Liver abscesses are secondary to the primary foci of infection In the ruminal wall. The leukotoxin and endotoxic lipopolysaccharide of *Fusobacterium necrophorum* may protect it from phagocytosis (Nagaraja and Chengappa, 1998; Tan *et al*., 1996). Also, the release of cytolytic products such as lysosomal enzymes and oxygen metabolites (free radicals), as a consequence of destruction of phagocytes, has a detrimental effect on the liver parenchyma. Hence, the role of antioxidant enzymes (i.e., zinc and/or copper superoxide dismutase [SOD] and glutathione peroxidase) is to protect tissues from oxidants (Berger, 1997; Geoffrey and Arthur, 2005; Howard and Smith, 1999). Abscesses contain many microbicidal and inhibitory constituents released from neutrophils including high concentration of calprotectin and lactoferrin (Bryant *et al*., 2004). Subsequent interaction of zinc and iron with calprotectin and lactoferrin, respectively, seems to limit the availability of those cations for bacterial growth, thus providing an innate or nutritional host defense against bacterial multiplication that may secondarily suppress microbial susceptibility to antibiotics (Bryant *et al*., 2004). This is the first report of the selenium, zinc, copper, iron, calcium, phosphorous and magnesium levels in pus and liver parenchyma that may discuss the effect of abscess on mineral status. According to the obtained results, all minerals concentration in pus exceeded normal serum values (Kojouri, 2001; Underwood and Suttle, 1999). Minerals have a major role on immune response to the infectious diseases. So that, calcium and phosphorous involved in cell membrane integrity and cellular function and selenium, copper and zinc in antioxidant activity (Berger, 1997; Geoffrey and Arthur, 2005; Howard and Smith, 1999; Underwood and Suttle, 1999).The adequate concentrations of Cu, Zn, Fe and Se in liver were summarized in Table 2. Results show that the concentrations of mentioned minerals in liver with abscesses are lower than adequate levels for Cu, Zn and Fe and at marginal level for Se. These findings may discuss the negative effect of liver abscesses on liver mineral status. According to the report of Stabel *et al*. (1993), indicated that Cu deficiency affects various physiological characteristics that may be important in immunological defense to pathogenic challenges. Woolliams *et al*. (1986), showed that Cu supplementation affected the resistance of sheep to bacterial infections (Woolliams *et al*., 1986). On the other hand, zinc has been shown to have a positive impact on immunity in stocker and feedlot cattle. Infection can also have a detrimental effect on Zn status in cattle. Infecting cattle with a bovine rhinotracheitis challenge increased urinary excretion, which caused a negative balance (Orr *et al*., 1990). The biological actions of selenium are mediated in most cases through the expression of at least 30 selenoproteins coded by 25 selenoprotein genes. These roles include the prevention of cancer, cardiovascular disease and viral

Table 1: Comparison of Cu, Zn, Se, Fe, Ca, P and Mg concentration (Mean Â±SE) in pus and liver parenchyma of cattle with liver abscesses

Minerals	Copper (mg kg^{-1})	Zinc (mg kg^{-1})	Selenium (mg kg^{-1})	Iron (mg kg^{-1})	Calcium (g kg^{-1})	Phosphorous (g kg^{-1})	Magnesium (g kg^{-1})
Pus	6.63Â±4.83	6.41Â±2.32	0.55Â±0.04	18.18Â±14.03	0.22Â±0.08	0.85Â±0.32	0.04Â±0.02
Liver	39.22Â±28.17	82.91Â±32.22	1.06Â±0.15	62.29Â±22.12	0.12Â±0.04	1.81Â±0.56	0.15Â±0.07

Table 2: Adequate liver concentration of Cu, Zn, Se and Fe in cattle (ppm on a DM Basis)*

Minerals	Copper	Zinc	Iron	Selenium
Liver	100-200	100-300	75-300	0.9-3.5

*Adapted from Puls (1990); Underwood and Suttle (1999)

mutation (Geoffrey and Arthur, 2005). Many investigators have reported a decrease in microbial activity of neutrophils isolated from selenium deficient cattle. Selenium deficiency is also associated with observed decreases in T-plymphocyte blastogenesis, neutrophil migration, chemotaxis, phagocytosis, killing potential and depressed antibody production of IgM and IgG (Howard and Smith, 1999; Kojouri and Shirazi, 2006). Iron as an essential nutrient for the growth of microorganisms, may decrease in serum after exposing the host to the infectious status. In this situation the body tends to sequester iron from the circulation into storage forms primarily in the liver and bone marrow, where it is retained and is relatively unavailable for erythropoiesis. This reaction may play a protective role by denying readily available iron to potential bacterial pathogens that require iron for rapid growth and multiplication (Carlson, 2002; Carter and Chengappa, 1991; Kojouri and Shirazi, 2006). In tissues the growth rate of bacteria reduces in lack of iron and zinc (Bryant *et al*., 2004).

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