

THE EFFECT OF ACIDEMIA ON MUSCLE BIOACTIVITIES IN CATTLE

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ABSTRACT

Muscle bioactivities have been studied in cattle suffering from acidemia in Basrah - Iraq. Thirty two adult cattle were used in this work, among these animals; twenty one clinically diseased cattle show signs of acidemia, Moreover eleven clinically healthy cows served as controls. Results revealed significant decrease in blood pH and bicarbonate, However significant increase in Creatine Kinase, Aspartate transaminase, Alanine transaminase, and Lactate dehydrogenase have been detected, Moreover significant change have been seen in lactate. It have been concluded that acidemia can affected cows result in deterioration of muscles bioactivities and myopathy might expected.

INTRODUCTION

The term *acidemia* describes the state of low blood pH, whereas *acidosis* are used to describe the processes leading to these state.(1) Therefore Acidemia was define as increase concentration of one or more organic acids in the blood or an increase in the hydrogen ion concentration of the blood (2). Acid-base balance is critical to maintaining the narrow pH range that is required for various enzyme systems to function ideally in the body, decreased pH is termed acidemia and is caused by an increase in the concentration of hydrogen ions (H^+) Whereas increased blood pH is termed alkalemia and is caused by a decrease in the hydrogen ions (H^+) (3). Acid-base disorders are those who are restricted to one primary alteration in CO_2 or HCO_3^- with or without a compensatory response (1).

Acidosis is a physiologic condition that tends to increase the concentration of hydrogen ions, which will increase the acidity of blood reflected by decrease blood

pH; this condition could be respiratory or metabolic in origin (4). An increase in the concentration of carbon dioxide, expressed as P_{CO_2} , is known as respiratory acidosis, whereas a decrease in the HCO_3^- is known as metabolic acidosis, both of these conditions causing the buffer equation to shift to the right, causing an increased H^+ and a decreased pH (5)

Different types of metabolic acidosis (mainly two), both are characterized by a decrease in the HCO_3^- but they differ in how that decrease occurs, Secretional metabolic acidosis is caused by loss of bicarbonate rich fluid such as diarrhea or saliva whereas Titrational metabolic acidosis is caused by the presence of non- CO_2 acids that titrate bicarbonate causing a decreased HCO_3^- , Titrational type metabolic acidosis is a result of increased endogenous or exogenous acids in the plasma (6).

Muscles are predominantly powered by the oxidation of carbohydrates and fats, but anaerobic reactions are also used, particularly by fast twitch fibers, these chemical reactions produce adenosine triphosphate (ATP) molecules that are used to power the movement of the myosin heads (7). All muscle cells produce adenosine triphosphate (ATP) molecules which are used to power the movement of the myosin heads (8).

Muscles have a low store of energy in the form of creatine phosphate which is generated from ATP and can regenerate ATP when needed with creatine kinase, Moreover muscles also keep a storage form of glucose in the form of glycogen ,However glycogen can be rapidly converted to glucose when energy is required for sustained powerful contractions(9) Within the voluntary skeletal muscles, the glucose molecule can be metabolized an aerobically in a process called glycolysis which produce two ATP and two lactic acid molecules in the process (10).

The muscles enzymes activities of creatine phosphate kinase (CPK), alanine aminotransferase (ALT), aspartateaminotransferase (AST), and glucose and urea have been shown to be elevated in many stressed animals during transportation and diseases and these enzymes are often used in assessing the extent of muscular damage and fatigue (11).

The aim of the present work was to evaluate bioactivities of cattle muscles affected with acidemia.

MATERIALS AND METHODS

Animals and study design:

The study was conducted on 32 local cattle breeds, 2-4 years old of both sexes in Basrah, Iraq. Twenty one local cattle breed was showing signs of acidemia with a history of ruminal acidosis and muscles weakness. Eleven locals clinically healthy cattle was served as controls .Classical clinical examinations were carried out in all diseased and normal cattle ; history was obtained and the data of body temperature, respiratory and heart rate were calculated.

Blood collection and analysis:

Ten milliliters of blood was drained from each cow by jugular punctures. Serum was separated to determine AST, ALT, CK, LDH, blood pH, bicarbonate and lactate, using commercial kits (CK,ALT,AST,LDH, Lactate and Bicarbonate: Randox, England while the pH: Chweiler, Germany)

Statistical analysis:

The significance of variations between diseased and healthy cattle was statistically analyzed using (SPSS) t.test, (12).

RESULTS

Disease animals show signs of anorexia ,depression , decrease milk production ,dehydration with sunken eyes ,dry muzzles and skin ,lameness ,polyuria followed by unuria ,constipation and recumbency ,Moreover body temperature, respiratory and heart rate were increased in diseased cows compared with controls. Diseased animals show significant decreases in blood pH and bicarbonate ,However lactate values show significant increase in diseased cows compared with controls .(Table 1)

Table (1): Values of blood pH, bicarbonate and lactate in diseased cows and controls.

Parameter	Diseased cows	Controls
pH	6.3±0.077	7.37±0.04 *
Bicarbonate mEq/L	11.29±0.73	26.9± 0.84*
Lactate mmol/L	0.44 ±0.068	0.36±0.012*

* (P<0.05), Values are mean ± standard error of mean

On the other hand diseased cattle show significant increases in CK, ALT, AST and LDH compare with healthy controls .(Table 2).

Table (2): Values of CK, ALT, AST and LDH in diseased cow and controls.

Parameter	Diseased cows	Controls
CK IU/L	429.1±17.21	184±13.8*
ALT U/L	93.19±6.75	30.72±4.56*
AST IU/L	326.14±13.75	77.27±3.95*
LDH U/L	2425.3±14.58	928±17.05*

* (P<0.05), Values are mean ± standard error of mean

DISCUSSION

Acidosis is a pathological condition associated with the accumulation of acid or depletion of alkaline reserves in blood and different body tissues, and characterized by elevation of hydrogen ions concentrations (2, 13). A similarity had been shown between regulation of hydrogen ions balance and other ions in the body, Therefore to get homeostasis, there must be a balance between the intake and the removal of hydrogen ions from the body (1).

Cows become acidotic when it absorbs more anions than cations while she becomes alkalotic when it absorbs more cations than anions (14).

There are three important primary systems that regulate the hydrogen ion concentration in the fluids to prevent acidosis or alkalosis, First the chemical acid-base buffer system of the body fluids, which immediately combines with acid or base

to prevent excessive changes in hydrogen ion concentration, Second the respiratory centers, which regulates the removal of CO₂ and carbonic acid (H₂CO₃⁻) from the extra cellular fluid and finally the kidneys, which can excrete either acid or alkaline urine, thereby reducing the extra cellular fluid hydrogen ion concentration to normal during acidosis or alkalosis (15,16,17).

In metabolic acidosis there were low arterial blood pH and a reduced plasma bicarbonate concentration, following the loss of bicarbonate or the addition of hydrogen ions, Extra and intra cellular buffering and respiratory compensation reduce the change in pH until the kidney can excrete sufficient hydrogen ions to correct the acid-base imbalance.(1,4)

In general acidemia will depress cardiac contractile activity and cardiac output therefore compensation will follow by increasing heart rate ,Moreover increased carbon dioxide tension of the blood and depletion of bicarbonate causes an increase in the depth and then the rate of respiration by stimulation of the respiratory center(18).

It had been found that acidemia causes varying degrees of depression of the central nervous system and muscular weakness, however CNS abnormality may developed because of the reduced ability of the cerebrospinal fluid to buffer acid-base changes which might resulted in cerebral edema the first causation of depression .(4)

The increased in urinary excretion of acids in acidosis also cause polyuria, which may be sufficiently severe to cause dehydration (19).

The term myopathy describes the non inflammatory degeneration of skeletal muscle that is characterized clinically by muscle weakness and pathologically by hyaline degeneration of the muscle fibers, The serum levels of some muscle enzymes are elevated and myoglobinuria is a common sing some times(8).

Results show significant increases in CK, ALT, AST and LDH in diseased animals, these results were agree with data reported by others (6,19) whom indicated myopathy resulted from necrotic muscle fibers ,Moreover (Qureshi and Lodhi (7) and Phillips et al (9) added that negative power on the pumping mechanisms of cell membranes due mostly to decrease glucose level which give its negative effect on the tissue and increase tissue waste which effect on the tissue vital activity then lead to muscular myopathy, However for assessing skeletal myopathy , serum transaminase activity, Creatine kinase Lactate dehydrogenase, can be aided (10),Whereby Creatine kinase is useful in diagnosing skeletal muscle or cardiac muscle degeneration,

Therefore Increases in CK can be caused by skeletal muscle damage and excessive exercise, muscle anoxia, from prolonged recumbency, myositis, nutritional myopathy, and myocardial infarction(7).

LDH is an intracellular enzyme which is widely distributed among the body and is found at high levels in tissues that utilize glucose for energy purposes , in addition LDH levels may be increased whenever there is cell necrosis , same results were indicated in the present study ,Moreover Transaminase is present in many tissues and is useful in evaluating muscle and liver damage in small and large animals for the fact that both ALT and AST were altered in muscular and hepatocellular membrane abnormal permeability ,same results were indicated in this study (20).

تأثير حموضة الدم على الفعالية الحيوية للعضلات في الأبقار

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الخلاصة

درست الفعالية الحيوية للعضلات لأبقارٍ عانت من ارتفاع حموضة الدم في البصرة - العراق . فحص اثنان وثلاثون من الأبقار المحلية أظهرت احد وعشرون منها علامات سريرية لحموضة الدم في حين استخدم احد عشر حيواناً من الأبقار المحلية كمجموعة سيطرة . أظهرت نتائج الدراسة تناقص معدلات باء هاء الدم بشكل جلي ومعنوي فضلا عن تناقص ايون البيكاربونات ، كما سجل معنوياً تزايد معدلات خمائر LDH , AST, ALT, CK, وزيادة معنوية في معدلات حامض اللاكتيك في الابقار المريضة بالمقارنة مع حيوانات مجموعة السيطرة ، استنتج من هذه الدراسة إن لحموضة الدم اثر سلبي ومؤثر جدا على الفعاليات الحيوية لعضلات جسم الأبقار لذا إمراض العضلة يمكن أن يحدث .

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