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"SOME BIOCHEMICAL STUDIES ON HUMANS" BLOOD BEFORE AND AFTER EXERCISE

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ABSTRACT

Fifteen healthy male student specification track and field were used at faculty of physical Eduction for Men, Zagazig University, for studying the effect of muscular exercise on some biochemical blood parameters. Blood samples for serum separation were obtained from five individuals representing the pre-exercise values. The rest of individuals was exposed to two types of exercise first (Exercise I) in which five individuals was running in the track for a duration of ten minutes. The second type of exercise (Exercise II) was carried also on five individuals for a duration of 20 minutes without stopage as soon as possible as the same steps of exercise I. At the end blood samples were also taken representing the exercise values. The collected data were differentiated into pre-exercise (control), exercise I and exercise II. Estimation of serum total proteins, albumin, globulins, urea, creatinine, glucose, AST, ALT, alkaline phosphatase, sodium, potassium, calcium, inorganic phosphorus and magnesium, levels were done to all individual groups before and at the end of exercise. Total proteins concentration significantly increased after exercise II, while a significant decrease of serum urea level were observed after exercise II. Moreover, serum albumin, Globulins, creatinine and glucose levels did not show any significant change.

Also, serum enzyme activities did not show any significant change after exercise compared with the pre-exercise values. Serum sodium and potassium concentration revealed a highly significant decrease after exercise II, while serum inorganic phosphorus and magnesium concentration revealed a significant increase. However, serum calcium level did not show any significant change. This study showed that, the sweating mechanisms during muscular exercise is advantage and valuable especially for waste metabolites like urea, but it may be harmful especially excess losses of essential minerals and some organic constituents as revealed by a significant changes in the level of most blood serum parameters.

INTRODUCTION

The sweat apparatus as an end organ plays an important role in the regulation of the levels of some organic and inorganic elements beside its main thermoregulatory function. Exercise induces major biochemical adaptations in skeletal muscle. The nutritional state, intensity and duration of exercise, and degree of physical fitness are all factors that qualitatively and quantitatively affect the metabolic pathways used in the generation of energy for muscular contraction. Overall, exercise will cause relative changes in certain biochemical analytes by altering the plasma volume of the individual. A change in plasma volume resulting from physical activity will vary depending on the intensity and the duration of the exercise bout. Generally, acute exercise of long duration causes the plasma volume to

be decreased, resulting in hemoconcentration. In this situation, a temporary relative increase in electrolytes and plasma proteins occurs.

Changes in carbohydrate metabolism specifically glucose disposal and turnover. That occur with short term and prolonged exercise, a long with the possible adaptations that take place after physical training, have been studied extensively in various human and animal populations.

Subsequent studies have shown that many factors determine the degree to which serum activities of several enzymes increase either during or after physical exercise. Deliberate or accidental trauma to tissues can lead to abnormal enzyme activities in the plasma. It was believed that, the protein is not used as a source of fuel to any appreciable extent during exercise. This may be based on the nitrogen excretion did not rise significantly following muscular work in human **(Astrand and Rodal, 1970)**. However, there have been several studies which indicated that significant alterations in protein metabolism can occur during and/or after exercise. These observations have been made during exercise on both humans **(Lemon et al., 1983)** and animals **(Lemon et al., 1985)**.

The major protein degradation and product in the human is urea representing 80 - 90% of total nitrogen loss in both urine and sweat with exercise **(Cerny, 1975)**. This suggested that protein utilization was increased as a result of muscular exertion **(Dohm et al., 1982)**.

Furthermore, strenuous or prolonged exercise can result in significant, transient alteration of the biochemical and hemostatic profile. However, modification of biochemical parameters via exercise occur owing to accumulation and consumption of metabolic fuels triggered by the sympathetic nervous system. There is also an increased permeability of cell membranes to proteins and enzymes. Also, the excessive loss of sodium and chloride through sweating results in salt depletion which leads to some ill effects, such as cramps, fatigue and irritability. This occurs if salt and water of the sweat are not replaced before extensive depletion of the body occurs **(Waterlow, 1947 and Ladell, 1949)**.

Accordingly, this work was planned to describe the effect of different durations of exercise on some biochemical blood parameters in healthy humans before and after muscular exercise.

MATERIAL AND METHODS

The present work was carried out in faculty of physical Education for Men, Zagazig University. 15 healthy male student specification track and field were used in this study the average body weight of the student 70 Kg. and their age ranged from 20 - 22 years old. Each man was subjected to an initial examination of urine and stool.

Venous blood samples was obtained from 5 individuals, those samples represented the control group or pre-exercise values. The rest of individuals was exposed to two types of exercise. First, (the light exercise) or Exercise "I" in which 5 individuals was running with their maximum speed without stopage in the track (circumference : 400 meters) for a duration of 10 minutes. At the end or after retrieval, blood samples were collected. The second type of exercise (heavy exercise) or Exercise "II" was carried out as soon as possible as the same steps of exercise "I" on also 5 individuals and repeated for another 10 minutes (for a duration of 20 minutes). After retrieval or at the end also blood sample were taken representing the exercise II values.

The collected data were differentiated into, pre-exercise (control), light exercise (Exercise "I") and heavy exercise (Exercise II). Venous blood samples were collected into plastic centrifuge tubes and serum were separated by centrifugation and stored at -20°C until the biochemical analysis could

be performed. All sera samples were analysed for total proteins, Albumin, globulins, urea, creatinine and glucose levels using colorimeteric methods according to **Granall et al. (1949). Bartholomew and Delonoy (1966); Doumas and Biggs (1972); Fawcett and Scott (1960); Schirmeister et al. (1964) and Trinder (1969)**, respectively. In addition to some enzymes as ALT, AST and alkaline phosphatase according to **Reitman and Frankel (1957) and Kind and King (1954)**, as well as some minerals as sodium and potassium by flame photometer, calcium, inorganic phosphorus and magnesium according to **Gindler and King (1972), Wootton (1982) and Gindler (1971)**, respectively. Statistical analysis of the obtained results were carried out using the method of **Snedecor and Cochran (1967)**.

RESULTS AND DISCUSSION

As shown in table (1) the levels of serum total proteins were increased non significantly after exercise I and increased significantly after exercise II. However, the values of serum albumin level showed a non significant increase followed by a non significant decrease after exercise I and II, respectively. The serum globulins levels were increased non significantly when compared with the pre-exercise values. similar, results were reported by **Abdel-Rahman (1991)** in horses. Who recorded that a non significant increase of both total proteins and albumin level during exercise when compared with the pre-exercise values. Haemoconcentration leads to masking an overall fall in protein levels. This was supported by several investigators in horses **(Kerr and Snow, 1982 and Judson et al., 1983)** and in mules **(El-Anwar, 1989)** but the increase was significant. This significant increase may be due to long time of exercise leading to marked haemoconcentration.

The values of blood urea level revealed a non significant difference during exercise I, whereas the level was significantly decreased after exercise II. The obtained results were in agreement with that recorded by **Abdel-Rahman (1991)**. Who observed that, the concentration of blood urea after exercise revealed little increase. Also, **Snow et al. (1982)** reported that the increase of blood urea must result from increased urea production as a result of protein catabolism. Whereas, the significant decrease of serum urea after exercise II may be due to the increased excretion of urea through the sweat.

The mean values of serum creatinine level revealed a non significant decrease during exercise I, whereas after exercise II the serum creatinine concentration showed a non significant increase in comparing with pre-exercise value. Similar results were recorded in horse ride by **Rose et al. (1977) and Snow et al. (1982)**. Probably, the greatest factor contributing to the plasma creatinine is the increased utilization of phosphocreatine by the working muscle. Moreover, **Snow et al. (1982)** showed a significant decrease in the rate of urinary creatinine excretion after exercise.

The mean values of serum glucose concentration Table (1) during exercise revealed a non significant hyperglycemia. The increase of serum glucose concentration, during exercise was in agreement with **Abdel-Rahman (1991) and Snow et al. (1982)** in horses at first half of ride. This may be owing to the mobilization exceeded muscle utilization. This mobilization resulted from combination of increased sympathetic activity, increased plasma glucagon **(Lucke and Hall, 1980)** and decreased insulin concentration **(Snow and Rose, 1981)**. Also, hyperglycemia may resulted from gluconeogenesis, probably from precursor metabolites (glycerol) produced, during the ride **(Snow et al., 1982)**.

The serum alkaline phosphatase activity revealed a non significant change with slight decrease after exercise. I and II as compared with

the pre-exercise values Table (2). The obtained data are nearly similar with that reported by **Apple** (1978) who observed that no change in alkaline phosphatase activity after an acute bout of exercise or with physical training. However, serum transaminases (AST and ALT) showed a non significant change to slight increase in the activities after exercise I and II, respectively. The obtained results were in agreement with those of **Apple** (1978) who stated that ALT is not elevated after an exercise bout, however, some investigators have reported slightly elevated serum activities in those individuals who exercise frequently. Moreover, AST are typically elevated after an acute bout of exercise and usually remain elevated in individuals who exercise daily **Noakes** (1987). The increase of serum enzyme activities may be attributed to both metabolic changes and physical damage to the muscle can play a role in contributing to the enzyme, release that occurs after exercise **Apple and McRae** (1983). Likewise, strenuous exercise, especially marathon running, in which there is a jarring of the torso and limbs, may cause the muscle fibers to become directly damaged, giving rise to the release of enzyme **Apple and McRae** (1983).

The obtained data Table (3) revealed a non and highly significant decrease in serum sodium level after exercise I and II, respectively, similar results were recorded in horses by (**Abd El-Rahman**, 1991), dog (**Locke and Hall**, 1978) and in man (**O'Connor**, 1977). The last author reported that the plasma sodium concentrations were more stable than those of potassium or chloride. This is probably related to the close relationship between plasma sodium values and fluid balance. Moreover, **Van-Beaumont et al.** (1973) found that a significant hyponatremia was recorded in man by the end of the ride due to its high losses in sweat during exercise. This significant result may be due to long time of exercise.

A highly significant hypokalemia after exercise was recorded in the present study. The obtained data was in agreement with **Rose et al.** (1980) and **Abdel-Rahman** (1991). The hypokalemia recorded after exercise may be due to dehydration (induced by excessive sweating) which leads to hyperosmolality of extracellular fluid causing intracellular dehydration with further loss of water, potassium and magnesium.

In the present study the serum inorganic phosphorus level showed a significant increase after exercise which agrees with the finding of **Rose et al.** (1983). Moreover, the serum calcium level also showed a non significant increased after exercise this could be attributed to the long time of exercise leading to haemoconcentration or lead to a decreased excretion of calcium, and phosphorus in urine (**Kachadorian**, 1972).

Regarding the serum magnesium, the obtained results showed a significant increase after exercise II compared to the pre-exercise values. Similar results were recorded by **Kachadorian** (1972) who observed that, an increase in serum magnesium level after mild exercise. The increase of serum magnesium level may be attributed to a decreased excretion of magnesium and other electrolytes in urine.

From the a fore mentioned results it could be concluded that the sweating process during muscular exercise induced a significant changes in the level of most serum biochemical constituents. This mechanism during exercise is advantage and valuable especially for waste metabolites like urea, but it may be harmful especially excess losses of essential minerals like Na, K, and some organic constituents. So, we recommend supplementations with minerals and good balanced diet to all exercising individuals before and after muscular exercise.

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Table (1): Serum total protein, albumin, globulin, urea, creatinine and glucose levels before and after exercise.

Parameters \ Statements	Pre-Exercise	Exercise - I	Exercise - II
Total protein gm/dl	7.06 ± 0.09	8.17 ± 0.13	8.59 ± 0.11*
Albumin g/dl	3.31 ± 0.14	3.75 ± 0.11	3.68 ± 0.11
Globulin gm/dl	4.24 ± 0.19	4.41 ± 0.22	4.78 ± 0.15
Urea mg/dl	14.38 ± 6.32	35.24 ± 0.08	15.24 ± 5.17*
Creatinine mg/dl	1.29 ± 0.18	1.28 ± 0.12	1.69 ± 0.06
Glucose mg/dl	62.82 ± 4.12	76.19 ± 10.21	82.86 ± 3.75

* ($P < 0.05$) Data are presented as mean ± S.E. ± S.E. = standard error.

Table (2): Serum ALT, AST and Alkaline phosphatase activities before and after exercise.

Parameters \ Statements	Pre-Exercise	Exercise - I	Exercise - II
Alkaline phosphatase u/L	56.79 ± 5.27	51.68 ± 5.48	45.04 ± 2.85
ALT u/L	16.2 ± 0.81	22.0 ± 4.51	27.0 ± 4.51
AST u/L	31.85 ± 2.14	34.3 ± 1.68	38.05 ± 2.85

Data are presented as mean ± S.E. S.E. = Standard error.

Table (3): Serum sodium, potassium, calcium, inorganic phosphorus and magnesium levels, before and after exercise.

Parameters \ Statements	Pre-Exercise	Exercise - I	Exercise - II
Sodium mEq/L	103.48 ± 3.93	153.05 ± 3.74	125.91 ± 3.07**
Potassium mEq/L	7.16 ± 0.31	5.64 ± 0.31*	4.36 ± 0.31**
Calcium mg/dl	9.92 ± 0.06	9.69 ± 0.18	9.95 ± 0.12
Inorganic phosphorus mg/dl	3.81 ± 0.14	4.34 ± 0.11*	4.37 ± 0.13*
Magnesium mg/dl	4.25 ± 0.06	4.41 ± 0.12	5.87 ± 0.22*

* ($P < 0.05$) ; ** ($P < 0.01$).
Data are presented as mean ± S.E. S.E. = standard error.

بعض الدراسات البيوكيميائية على دم الإنسان قبل وبعد المجهود البدنى

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أجرى هذا البحث على طلبة تخصص ألعاب القوى بكلية التربية الرياضية للبنين جامعة الزقازيق بهدف تحسين الأداء التدريبى ورفع الكفاءة الصحية والأمان للطلاب الرياضيين ولقد تم إجراء هذا البحث على عدد ١٥ طالبا وكانو جميعهم فى حالة صحية جيدة حيث تم دراسة تأثير التدريبات الرياضية والإجهاد العضلى على بعض مكونات الدم البيوكيميائية وذلك بتصميم نوعين من التجارب : الخفيف والشاق ولقد تم أخذ عينات الدم قبل وبعد التمارين مباشرة (الجرى) على فترات مختلفة من الوقت ١٠ – ٢٠ دقيقة لمتابعة التغيرات التى قد تحدث فى مكونات دم كلا منهم نتيجة لهذا المجهود البدنى وقد أسفرت النتائج على الأتى . أظهرت التحليلات الكيميائية للدم إرتفاعا معنويا فى مستوى البروتين الكلى والفوسفور الغير عضوى والماغنسيوم وعلى العكس إنخفاض كلا من نسبة اليوريا وعنصرى الصوديوم والبوتاسيوم بعد التمرينات الرياضية بشقيها أما باقى مكونات الدم فلم تسجل النتائج أى تغيرات معنوية بعد أداء المجهود البدنى عند مقارنتها بقبل المجهود العضلى ونستخلص من هذه الدراسة أن عملية العرق أثناء التمرينات العضلية الرياضية وكذلك المجهود البدنى يصاحبهما فقدان لكميات كبيرة لا يستهان بها من العناصر والأملاح المفيدة للجسم ونظرا لذلك يجب تعويض الأفراد الرياضيين الممارسين لمثل هذا النوع من الإجهاد العضلى بالقدر المناسب من هذه العناصر بالإضافة إلى التغذية الجيدة المتوازنه.