Sys Rev Pharm 2020; 11(2): 100 – 103
A multifaceted review journal in the field of pharmacy
E-ISSN 0976-2779 P-ISSN 0975-8453

The Effect of High Temperature on the Hematological Parameters of Bakery Workers

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Article History: *Submitted: 15.11.2019* *Revised: 18.12.2019* *Accepted: 13.01.2020*

ABSTRACT
The present study included the determination of the effect of continuous exposure to high temperatures on a number of hematological variables of a group of male workers exposed to occupational pressure in bakeries. The study included 50 workers exposed to heat and 20 volunteers as a control group. The workers group was divided into three age groups (15-25, 26-35, -36-50 year) according to their annual exposure to heat in addition to the smoking factor. The results showed a clear variation in variables related to erythrocytes between the three age groups, The RBC and Hb level showed a relatively low level in the second age group (4.8 10^3 / ml and13.0 mg/dl), respectively.accompanied by a marked increase in the level of platelets in the first age group and the highest average (300 L / 10^9) compared with the control group. The variables related to the white blood cells showed a significant difference, with a significant increase in the total number of WBC, monocytes and granulocytes. The highest average reached in different groups (10%, 0.1% and 0.62%) respectively. Furthermore, a relatively low percentage of lymphocytes were observed in the three groups and the lowest average was (0.324%) compared with the control group. While results related to the effect of smoking factor with temperature showed significant differences, a relative decrease in the level of RBC was observed in the non-smoking workers group. The results of Hb, PCV and PLT concentrations showed a significant increase in the smoking group, reaching the highest mean (14.4 ml / dl, 45% and 264 L/ 10^9), respectively, compared with non- smokers and the control group. The WBC value also showed a relatively high increase in the smokers group (8.5%), accompanied by a significant increase in the percentage of lymphocytes, monocytes and granulocytes and the highest mean was (2.5%, 0.6% and 5%), respectively in non-smokers compared to smokers. The results of the effect of the temperature exposure period at an annual rate were relatively different, The group exposed to heat in bakeries for several years (15-30 year) was affected by its hematological variables higher than the group exposed to heat for less than years (1-15 year). Therefore, the present study suggests a high temperature effect of bakery on some hematological variables in workers.

Key words: heamatological, high temperature, Bakeries
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DOI: 10.5530/srp.2020.2.16

INTRODUCTION
Human body score temperature varies from day to day and from time to time, but theses fluctuations are small, usually no more than 1.00C. Humans are homoeothermic and body temperature is regulated at about 37 ^{0}C +/- 1^{0}C. The thermoregulatory center in the hypothalamus plays a very active role in keeping body temperature in the normal range. External (climatic) and internal (metabolic) heat sources influence body temperature [1]. Heat stress is the most important climatic stress that even threatens the survival of the animals [2]. Environmental factors including the ambient temperature, relative humidity and metabolic heat produced from the maintenance and productive process contribute to the heat stress [3].Heat stress is a combination of environmental conditions when the ambient temperature is higher than the temperature range of animal´s [4]. Heat stress is responsible for alterations of the immune response which changes depending on the type of immune response and the length of time that human are exposed to the stressor [5]. Workers in industries are exposed to high temperature around them, as a result of technical processes which heat the atmosphere [6]. Such as the workers in front of the bakery and in such cases may prevent the heat of the human body to lose the appropriate amount of heat, which leads to increased heat and resort in this case to try to increase the means of loss of heat by expanding the blood vessels surrounding the skin to increase the temperature of the skin and increase the amount of sweat In an attempt to increase heat loss by evaporation, the body's ability to adapt is limited and disturbances and diseases may occur [7]. When the organism is exposed to different types of stress, it results in the formation of a thermal shock protein that includes stress exposure to high temperatures and various chemicals materials [8]. So recent studies have focused on studying the metabolic and biochemical events of high-temperature exposed organisms because they are essential to understanding the environmental risks of pollution and reflect the damage to cells, tissues and their bodies [9]. The continuous exposure to high heat increases the kinetic energy of all cellular molecules. This energy is then spread and distributed within the cell. It is possible that the occurrence of hydrolysis or accumulating proteins of heat in the cell and within different cellular organs such as nucleus, mitochondria and microorganisms [10]. Furthermore, the decline in cognitive performance in hot environments has been reported by many studies as a cause that can lead to human errors due to reduced attention and increased likelihood of unsafe behavior [11].

MATERIALS AND METHODS
Experimental design
This study included (50) workers in bakery subjected to high temperature, randomly selected. This group was

divided into three age groups. Prior to the study, the workers' approvals were obtained and their information was collected according to the detailed questionnaire, which included name, age , place of residence, duration, number of hours of daily exposure and smoking status. Workers with chronic diseases were excluded, as well as (20) natural persons who were not exposed to high temperatures (as a control group). Blood tests were performed for the blood parameters (Hb), (PCV), (WBC), (PLT) and the differential number of white blood cells using the CBC device.

Statistical analysis

The Statistical Analysis System –SAS (2012) was used for the analysis of data, and to determine the significance differences between treatments according to the Completely Randomized Design-CRD, and compared the significant differences between the mean by Least Significant Differences (LSD). with a probability level ($p < 0.05$)

RESULTS AND DISCUSSION

The effect of temperature on the blood parameters of different age

The results related to erythrocytes and white cells in Table (1) showed a significant variation, there was a significant decrease in the values of RBC, Hb, PCV, PLT in the second age group exposed to heat effect. It was accompanied by a significant increase in the value of WBC and the proportion of Monocyte of the first age group, lymphocytes recorded a significant decrease in all groups compared to the control group. There was a negative relationship between temperature and blood values. The rise of temperature in bakeries led to lower values of erythrocytes, increased temperature has reduced hematocrit, erythrocyte count, hemoglobin concentration, and platelet count in the second age group. The results of these parameters appear to resemble those of the lower values of RBC, Hb, and PCV during the summer, Which in some studies found that higher temperatures increase breathing, body temperature, oxygen consumption and water loss,. Taking an increase of oxygen generates molecular pressure in the blood, thus reducing the number of red blood cells, Hb and PCV [12-14]. Others, believe that red blood cells are decreasing due to limiting cellular metabolism, as an organism's efforts to reduce metabolic heat production [15]. Various studies suggest that acute exposure to a hot climate leads to an expansion of plasma volume and a decrease in Hb level [16-18]. In hot weather the concentration of Hb in the blood decreases, and this leads to a decrease in the level of oxygen in the blood may be due to a decrease in the affinity of Hb to bind oxygen, or because of the low molecular pressure in the air gases [19]. Blood parameters are good indicators of health status, and their evaluation is important in assessing the animal's response to various stressful conditions, and different levels of blood parameters reflect metabolic activities during stress conditions, confirmed[20] that PCV and Hb values decreased significantly in goats exposed to heat stress.

Table 1: Effect of temperature on the blood parameters (mean±sd) of bakery workers

Parameters	Group 1 age categories (15-25)	Group 2 age categories (26-35)	Group 3 age categories (36-50)	Control
RBC(10^3/ml)	0.09± 5.14	0.11±4.85	0.12±5.03	0.17±5.07
Hb (mg/dl)	0.43±13.85	0.30±13.0	0.32±13.57	0.8±14.08
PCV (%)	1.05±45.24	11.58±42.67	0.60±45.63	0.91±43.65
Platelets (L/10^9)	15.8±286.94	11.5±242.67	16.8±256.23	10.5±244.55
WBC (10^3/ml)	0.48±8.49	0.34±7.36	0.74±9.50	0.37±7.96
Lymphocyte (%)	0.02±0.354	0.01±0.324	0.02±0.324	0.01±0.385
Monocyte (%)	0.02±0.095	0.002±0.066	0.003 ±0.076	0.001±0.068
Gran. (%)	0.01±0.563	0.01±0.609	0.02±0.597	0.008±0.565

Effect of smoking and temperature on blood parameters

The interaction of the smoking factor with the temperature had a clear effect. Table (2) shows the high values of RBC, Hb, PCV, PLT and WBC values in the smokers group of workers compared to non-smokers, the percentage of lymphocytes and granulocytes decreased in the smokers group. The results of our study were consistent with the results of previous studies that showed a decrease in the proportion of lymphocytes and an increase in the total number of white blood cells and monocytes in chickens exposed to high temperature and low value of hematocrit [21]. Our findings have shown that smoking also has negative effects on blood parameters and that the significant increase in hemoglobin concentration in the smokers group is consistent with previous studies which confirmed that the increase in Hb concentration is by exposure to carbon monoxide, and some authors suggest that the increase could be a compensatory mechanism [22]. Increased erythrocytes and hematocrit values in worker smokers can be explained by the fact that hypoxia resulting from increased carboxy hemoglobin leads to increased excretion of erythropoietin, and thus increased RBC [23,24]. The values of white blood cells were higher in smokers consistent with previous studies, and several factors led to an increase in WBC, Some authors claim that the increase could be the result of nicotine induced by catecholamine and steroid hormones from the core of the adrenal gland. It is known that the increase in the level of some internal hormones leads to an increase in the number of white blood cells [25,26]. In addition, the effect of tobacco smoke on the respiratory tree with its resulting inflammation can contribute to increased WBC [27].

Table2: Effect of smoking on the blood parameters (mean ± SD) of bakery workers

Parameters	Smoker	Non-Smoker
RBC(10^3/ml)	0.06±5.01	0.13±4.98
Hb (mg/dl)	0.42±14.11	0.22±13.68
PCV (%)	0.52±45.55	1.32±44.09
Platelets (L/10^9)	10.3±264.20	16.9±261.00
WBC (10^3/ml)	0.35±8.45	0.64±8.07
Lymphocyte (%)	0.01±0.348	2.08± 2.40
Monocyte (%)	0.01±0.081	0.51±0.581
Gran. (%)	0.01±0.581	4.47±5.08

Effect of period of work / year on the blood parameters

The greater the exposure period, the greater the effect on physiological variables of workers as shown in Table (3), lower values of RBC, Hb, PCV, PLT in the exposed group for more than years , the higher the value of WBC and monocyte the greater the exposure period accompanied by a decrease in the proportion of lymphocytes. In these results we obtained high values of WBC in exposed workers for more years, and were similar to the study [28] Which showed the appearance of white blood cells during the summer where. On the other hand, both RBC and Hb decreased with increased exposure to heat, and this may be due to the effect of hemodialysis, because at elevated temperatures an increase of water is transported into the circulatory system, and this is considered a mechanism to cool the body through evaporation [29]. Reported [30,31]that heat stress causes the release of corticosteroid from the adrenal glands, followed by an increase in the number of leukocytes and neutropenia, eosinophils and lymphocytes. The fact that stress affects the functions of the human body and oxygen, possibly due to various factors, these factors are related to the functions of the human body [32]. Others suggest that high heat causes difficulty breathing due to increased air density and bronchospasm [33]. It was found that there are differences in values for all blood parameters between exposure before and after heat, these results indicate the cellular compartment of blood shrunk relative to the plasma element during the period of thermal adaptation [34].

Table3: Effect of duration of work / year on the blood parameters (mean ± SD) of workers

Parameters	Group 1 (1-15) year	Group2 (15-35) year
RBC(10^3/ml)	0.14±5.01	0.07 ±5.00
Hb (mg/dl)	0.27±14.18	0.24±13.70
PCV (%)	0.69±45.53	0.65±44.46
Platelets (L/10^9)	10.7±265.40	11.3±250.63
WBC (10^3/ml)	0.33±8.26	0.82±8.61
Lymphocyte (%)	0.01±0.342	0.02±0.315
Monocyte (%)	0.003±0.070	0.01±0.082
Gran. (%)	0.01±0.610	0.02±0.585

CONCLUSIONS

The results of our study showed important baseline data to examine the health status of bakery workers and can help them to understand the health hazards resulting from the effect of high temperature, this study concludes that high temperatures in some cases significantly effect on blood parameters in workers.

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