

The correlation between health status and milk quantity and quality in cows exposed to solar radiation in climate conditions of Transylvania

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INTRODUCTION

This paper presents some of the results belonging to a larger study which wants to find out if milking cows are submitted to the heat stress induced by the solar radiation.

On this purpose there were observed the behavioural changes and there were determined the main physiological indexes, haematological indexes, the level of the thyroid hormones and in the end, the level of the antioxidant systems in blood and their correlation with milk production and quality changes.

The preliminary studies demonstrated that the month May represents the month for thermal comfort in cattle, which was considered in the study as reference month and August was the month when the cows were submitted to the most increased thermal stress.

THE PURPOSE OF THE PAPER

Is to observe if in dairy cattle, exposed to the solar radiation, could be noticed a certain reaction of the organism related to the oxidative stress, manifested by the increasing of the level of the antioxidant enzymes such as: superoxide dismutase (SOD), catalase and peroxidase in August comparing to May.

The main aim of this paper is to emphasise the direct and the indirect effects of caloric solar radiation on the status of health and milk production and quality in dairy cows in the climate conditions of Transylvania.

GENERAL ASPECTS

First of all, in order to have a better view, we present some considerations regarding the antioxidant systems in blood and ROS (Reactive Oxygen Species). The main ROS are: singlet oxygen, superoxyde radical anion, hydrogen peroxide and their radicals.

Normally, the organism is protected by a large series of enzymatic antioxidants systems, which interact together. These are mainly represented by superoxide dismutase, catalase and peroxidases. These antioxidants systems have the role to control the forming and accumulation in the organism of the reactive oxygen species (ROS).

ROS may be formed in organism, both endogen and exogenous under the action of some physical or chemical agents. *[Dejica, 2000].*

GENERAL ASPECTS

The solar radiation acts, also directly and also indirectly by increasing the values of environmental temperatures. The most common index of heat stress (Temperature – Humidity Index - THI) is calculated using temperature and relative humidity (Yousef, 1967).

$THI = (1.8 \times T + 32) - [(0.55 - 0.0055 \times RH) \times (1.8 \times T - 26)]$ where T=Temperature and RH=Relative Humidity

Dairy cows begin to suffer whenever the THI exceeds 72 (Jones, 1999; West, 1995, 2000). Under these circumstances we recorded the forming, respective the accumulation in excess of the ROS which determines, so called “oxidative stress”.

The oxidative stress is produced by the increasing of the free radicals or ROS production and / or by the reduction of the antioxidant defence. (Travisian *et al.* 2001, *quot. by* Bernabucci *et al.* 2002).

When the forming of the ROS rate increases, so that they can not be further neutralised by the action of the antioxidants systems, the oxidative stress is produced (Sies, 1991, *qout. by* Bernabucci *et al.*, 2002).

MATERIAL AND METHOD

-The first changes to be noticed are those related to the dairy cows behaviour.

- The observations regarding the behaviour changes were carried out on 87 cows and heifers on pasture and there were recorded behavioural accommodations in sense of thermogenesis' reduction (reduction of the voluntary motions and of the appetite) and of the thermolysis' intensification (intensification of perspiration and apparition of the thermal polypnea).



MATERIAL AND METHOD

During the days of the experiment there were also recorded the meteorological data, such as: air temperature, relative humidity and there were calculated the maximum **THI index values**. The meteorological data registration was made in Meteorological Station belonging to USAMV Cluj-Napoca.

The determinations of the antioxidant enzyme's level were made in the Biochemistry Laboratory belonging to the Faculty of Veterinary Medicine Cluj-Napoca.

The determination of **SOD** was made using **NBT method**, based on pyrogallic oxidation in the presence of nitro blue tetrazolium chloride (NBT) resulting a stained product which can be photometric dosed at 540 nm (Ciurdaru V, 1999).

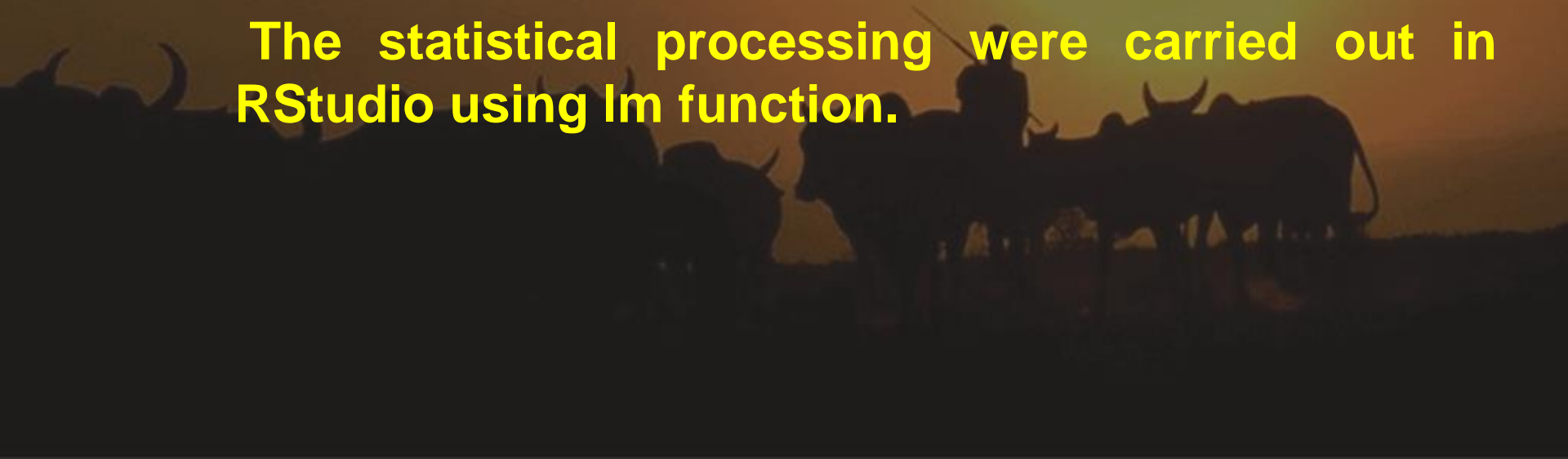
The **catalase** activity was made using photometric method with **potassium bichromate** (after Sinha A., 1972, adapted by Sanda Andrei 2004) which is based on the reaction of the hydrogen peroxide with potassium bichromate.

The **peroxidase** dosing was made using the **guayacol method**, which is based on the guayacol oxydation as hydrogen donor, resulting a coloured product which can be photometric dosed at 470 nm (Ciurdaru V, 1999).

MATERIAL AND METHOD

We correlated the variations of: SOD, Peroxidase and Catalase' s values recorded in May respectively August, with milk quality parameters: Fat, Proteins and Lactose and comparatively milk quantity.

The statistical processing were carried out in RStudio using lm function.



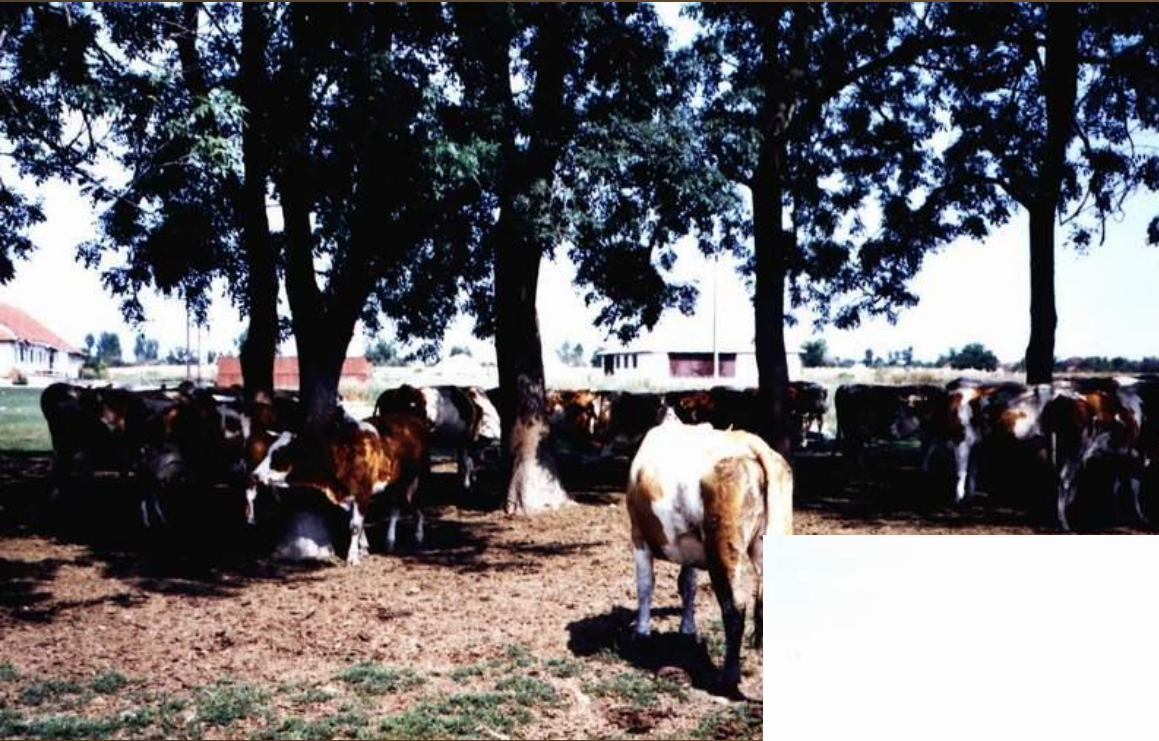
RESULTS AND DISCUSSIONS

In May, the calculated values for maximum THI were lower than 72, all the time of the day, varying between 43.4 and 67.5, so they are within the limit for the thermal comfort in cows.

On the contrary, the maximum THI index obtained in August was 82-83, being increased with 10.27% over the limit of 72, which represents the limit over which the thermal discomfort appears in milking cows.



RESULTS AND DISCUSSIONS



RESULTS AND DISCUSSIONS

The observations made by us, recorded an increasing of the main physiological indexes (such as respiratory rate, heart rate, internal and cutaneous temperature, variation of the blood indexes and thyroid hormones) determined us to study the reaction of the cows' organism at the cellular level, regarding the thermal stress.



RESULTS AND DISCUSSIONS

Values of the antioxidant enzymes level (mean \pm SD) in August compared to May

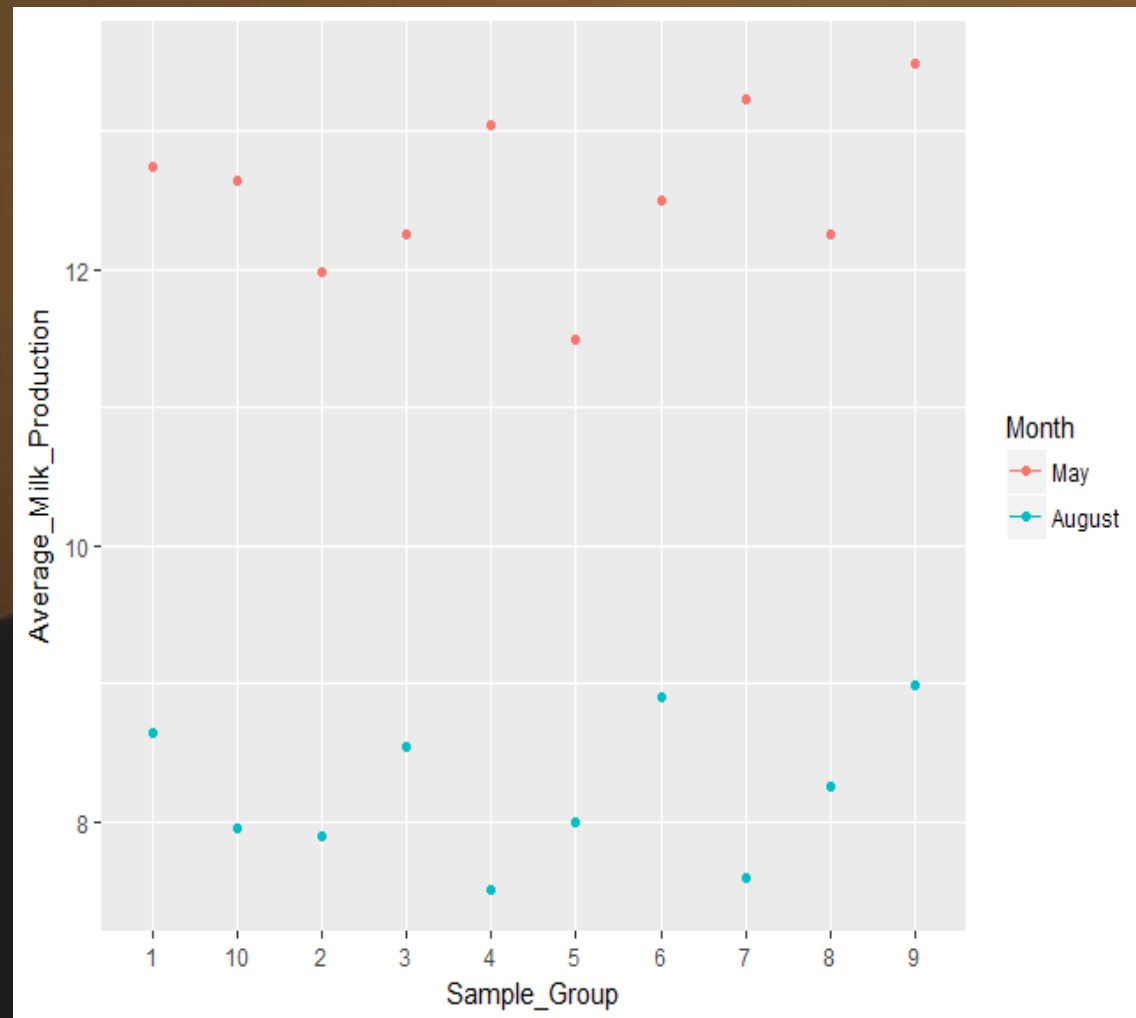
	SOD Activity (U / ml)		Catalase Activity (Ncat / ml)		Glutation Peroxidase Activity (Px / ml)	
	May	Au-gust	May	August	May	Au-gust
Mean (X \pm SD)	30.57 \pm 7.28	59.73 \pm 20.70	1917.53 \pm 1411.84	3434.18 \pm 1930.55	70.58 \pm 15.62	78.88 \pm 7.95

RESULTS AND DISCUSSIONS

We obtained a positive correlation between Fat values and SOD values, $R^2=0.64$, $p<0.05$. If we consider also the parameter Month, $R^2=0.67$, $p<0.05$. So, we conclude that the parameter Month contributes with 3% to the Fat decrease values. The parameters Fat and Catalase are negative correlated, $R^2=0.56$, $p<0.05$. Adding the parameter month, we obtain $R^2=0.62$, $p<0.05$. We conclude that the parameter Month contributes with 6% to the Fat level's decrease. Between the parameters Fat and Peroxidase we recorded a negative correlation, $R^2=0.95$. The factor month generate the correlation expressed by $R^2=0.96$

RESULTS AND DISCUSSIONS

We note a **negative significant correlation** between milk production (l/day) recorded in May and milk production (l/day) recorded in August, $R^2=0.94$ (Fig. 1).



RESULTS AND DISCUSSIONS

Lactose and catalase: negative correlation, $R^2=0.56$, $p<0.05$.

Lactose and catalase and month, $R^2=0.66$, $p<0.05$.

Lactose and peroxidase: negative significant correlation, $R^2=0.95$

Lactose and peroxidase and month: $R^2=0.96$

Protein and catalase: negative significant correlation, $R^2=0.57$

Protein and catalase and month: $R^2=0.67$

Protein and peroxidase negative significant correlation, $R^2=0.95$, $p<0.05$.

Protein and peroxidase and month $R^2=0.96$, $p<0.05$.

RESULTS AND DISCUSSIONS

The formation and the accumulation of the ROS determine the so-called „oxidative stress” which represents the totality of the oxidative degradation produced by the oxygen free radicals. (Olinescu, 1994).

The oxidative stress is produced by the increasing rate of free radicals production or ROS and/or by the decreasing of the antioxidant defence determined by metabolic disturbances. (Travisian 2001, quot. by Bernabucci, 2002).

So, when the ROS speed formation increase they can not be neutralized any longer by the antioxidant enzymes action and the oxidative stress is produced. (Sies, 1991, quot. by Bernabucci, 2002).

CONCLUSIONS

1. During the hot summer days, when the values of THI exceed 72, the oxidative stress is produced in dairy cows, which is mainly manifested till the cellular level, by the increasing of the antioxidant enzymes activity.
2. There was recorded a direct co-relation between the increasing of the antioxidant enzymes level and the increasing of the THI.
3. There were recorded behavioural accommodations in sense of thermogenesis' reduction (reduction of the voluntary motions and of the appetite) and of the thermolysis' intensification (intensification of perspiration and apparition of the thermal polypnea).
- 4 It was recorded a positive correlation between Fat values and SOD values, $R^2=0.64$, $p<0.05$. If we consider also the parameter Month, $R^2=0.67$, $p<0.05$. contributes with 3% to the Fat decrease values.
5. Parameters Fat and Catalase are negative correlated, Parameter Month contributes with 6% to the Fat level's decrease.
6. We note a negative significant correlation between milk production (l/day) recorded in May and milk production (l/day) recorded in August,

**THANK YOU VERY MUCH
FOR YOUR ATTENTION !**

