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Body Temperature and Haematological Indices of Boars Exposed to Direct Solar Radiation

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Abstract:
The effects of exposure to direct sun light on body temperature (BT) and blood profile (BP) of boars was studied using Large White and Large White x local F_1 crossbred boars. The experiment involved three treatments: zero exposure (T_1); 45 minutes (T_2) and 60 minutes exposure (T_3). Pigs were exposed between 13:30 and 14:45 hr daily for 4 weeks. Body temperature of control and exposed pigs was measured daily at the end of exposure. Blood samples were collected and analysed for LC, EC, HbC and PCV while MCV, MCH and MCHC were calculated from EC, HbC and PCV values. Ambient temperature (AT) averaged 27.84 ^oC indoors and 40.54 ^oC outdoors over the experimental period. There were significant genotype, treatment and interaction effects on most of the parameters studied. The LW boars were more severely affected by exposure to direct sunlight than the crossbred boars. It was concluded that wallow pits and shades should be provided for extensively managed pigs to enable them cope with the high thermal radiation and heat stress inherent in the tropics. Again, crossbreeding and selection for heat tolerance would ensure improved productivity in future.
Key word: blood profile, body temperature, erythrocyte indices, Large White, local boar, thermoregulation.

1. Introduction

Extensive system of swine production still thrive in remote villages of South eastern Nigeria. Pigs are housed in the night but let-out to scavenge in the morning. The farmers aim to save cost. Supplemental feeding is seldom provided. In the humid tropics, pigs reared outdoors are exposed to direct heat of the sun during the day and to a myriad of other environmental stressors including high ambient temperatures (temperatures above their thermoneutral zone) with attendant thermal stress (Nardone *et al.,* 2006; Nwosu and Ogbu, 2011), high humidity, rainfall etc. Night period offer opportunity for recovery from daily heat stress consequent upon the reduced ambient temperature and enables the pigs to cope with the hot tropical weather. However, the daily heat stress compromise productivity and physiological function (Rowlinson, 2008; Mader *et al.,* 2009; Kumar *et al.,* 2011). The negative impacts of elevated ambient temperature on performance, health and well being of pigs have been well noted (Renaudeau, 2007; Zumbach *et al.,* 2008). Traditional (out door) pig production is hence characterised by poor performance: poor growth rate, poor feed efficiency, low conception rate, abortion, fewer and smaller litters (Ricald and Lean, 2000; Huynh *et al.,* 2005).

Rectal temperature is an indicator of core body temperature in animals (Lucas *et al.,* 2000). Rise in rectal (body) temperature above normal range is therefore an indication of thermal stress. As ambient temperature rises above the thermoneutral zone and approaches the body temperature, sensible heat loss decreases due to lower thermal gradient (Lucas *et al.,* 2000). Pigs under heat stress must therefore alter behaviour and physiology to increase heat loss, reduce heat production and restore normothermia and homeostasis but with costs to productivity (Huynh *et al.,* 2005; Lin *et al.,* 2005). These effects have been noted to be more severe in the exotic breeds reared under tropical climates (Hansen, 2004). A breeding strategy that exploits the higher performance potentials of exotic breeds of pigs and the adaptability of their indigenous counterparts will greatly enhance animal well being and productivity under tropical environments. Thus crossing exotic Large White pigs with the indigenous pig could yield animals that combine their productive potentials.

Blood is a regulatory, protective and homeostatic tissue (Nasyrova *et al.,* 2006; Eze *et al.,* 2010). Haematological profile provides a means of assessing the internal environment and to understand the cause (s) of the observed physiological indices of an animal under different environmental stimuli. There is paucity of information on the effects of short term exposure to direct sunlight on the body temperature and blood parameters of Large White (LW) and crossbred (LW x LC) pigs in the humid tropical region of Nigeria. Information on the changes in blood tissue of pigs under heat stress will enable appropriate short and long term adaptation and mitigation measures to be adopted against heat stress. The present study was therefore, undertaken to assess the body temperature and haematological parameters of boars exposed to different durations of direct sun light in the humid tropical environment of Nsukka, Southeast Nigeria.

2. Materials and methods:

The study was carried out at the piggery unit of the teaching and research farm of the Department of Animal Science, University of Nigeria, Nsukka located on latitude 05^o 22^I North and longitude 07^o 24^I East in South

eastern Nigeria. Nsukka belongs to the humid tropical rainforest zone. Annual rainfall ranges from 1567.05mm to 1846.98mm. Natural day length is 12 to 13 hours while average minimum and maximum daily temperatures are 20.99 ^{o}C and 42.33 ^{o}C, respectively. Relative humidity ranges from 48.68% to 76.20% (Metrological Centre, Crop Science Dept., UNN, 2009. unpublished). The study was conducted during the dry season (January, 2009) and lasted for 4 weeks.

2.1 Experimental animals

Twenty-four (24) randomly selected boars belonging to two genotypes (12/genotype) namely: Large White (LW) and Large White x local (LW x LC) F_1 crossbred boars were employed for the study. The boars were 6 months of age at onset of the experiment and weighed on the average 50.14 ± 5.12 kg and 46.65 ± 4.80 kg ($P > 0.05$) for LW and crossbred boars, respectively. The LW boars were progenies of an inbred LW parent stock maintained in the Departmental teaching and research farm. The crossbred boars were generated by crossings between the LW stock and inbred local pigs whose parents were purchased from a native pig farmer in the study area. These pigs were reared in the same pig house from weaning to 6 months of age when they were selected for the study. The pigs were randomly shared into 3 experimental units (8 boars/treatment; 4/genotype) namely: treatment 1 or control (housed), treatment 2 (45 minutes exposure) and treatment 3 (60 minutes exposure). All exposures took place between 13.30 and 14.45 h daily. Animals in the control were reared intensively inside the Departmental pig house roofed with asbestos. The experimental pens (indoor) measured 6.0 x 8.0 m each giving a space allowance of 6.0 m^2/pig. Pigs exposed to solar radiation were similarly housed prior to exposure but were moved into paddocks situated directly in front of the pig house during exposure. The indoor pens opened directly into the outdoor paddocks. The paddocks (for 45 and 60 min. exposure) were demarcated using wooden poles and expanded metal. Each paddock provided an area of 6.0 m^2 per pig. Movement into the paddocks was made easier and less stressful by training the pigs to feed in the paddocks during the period of exposure. A pig hurdle was also used to facilitate movement to and from the paddocks. Exposure duration was measured with the aid of a stop watch. At the end of the exposure period, animals were herded back into the pig house for blood collection. A 14 day pre-experimental period was observed to enable the animals get used to movement to and from the paddocks and to handling for data collection. The pigs were fed 6 % of their weekly body weight as daily ration while cool clean water was provided *ad libitum*. Apart from the routine management practices of feed and water provision, cleaning, movement to and from the exposure paddocks and handling for data collection, pigs were minimally disturbed during the experiment. The experimental procedures complied with the provisions of the University of Nigeria, Nsukka Ethical Committee on the use of animals for biomedical research (2005).

2.2 Data collection:

2.2.1 Blood collection and Analysis: 5mls of blood was collected/animal through the ear vein and into an EDTA bottle. Sampling was done immediately after exposure in both control and exposed groups. Blood samples were collected and evaluated twice per week for leukocyte count (LC), erythrocyte count (EC), haemoglobin concentration (HbC) and packed cell volume (PCV) using simple haematological procedures. Mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were calculated from EC, HbC and PCV values (Baker *et al.,* 2000; Chernecky and Berger, 2001).

2.2.2 Body and ambient temperatures: Daily body temperature (BT) was measured as rectal temperature at the end of exposure period using a digital Celsius thermometer. Body temperature of animals in the control was also measured at the same time as for the exposed boars. Ambient temperature (AT) of the control pens and exposure paddocks was measured using a dry and wet bulb thermometer hung 1 m above the animals. These measurements were taken at the end of exposure for each experimental unit.

2.2.3 Sunlight intensity: Records of daily intensity of sunlight was obtained from a nearby weather station belonging to the Department of Crop Science, University of Nigeria, Nsukka. Table 1 presents the monthly mean daily solar radiation from June 2008 to June 2009 for the study area.

2.3 Data Analysis

The experimental design was 2 x 3 factorial arrangement of treatments in a completely randomised design (CRD). That is, two genotypes and three durations of exposure. Data were subjected to analysis of variance (ANOVA) using the Genstat computer programme (Genstat discovery edition 3.0, 2009) to test for main and interaction effects. The statistical model is:

$$\chi_{ijk} = \mu + G_i + E_j + (GE)_{ij} + \varepsilon_{ijk}$$

where, χ_{ijk} = the observation on the k^{th} boar belonging to the i^{th} genotype subjected to the j^{th} treatment; μ = overall mean; G_i = effect of the i^{th} genotype; E_j = effect of the j^{th} duration of exposure; $(GE)_{ij}$ = interaction effect of genotype by duration of exposure; ε_{ijk} = residual. Significantly different means were separated using the Least Significant difference. Comparison between genotypes subjected to the same treatment was done using independent t-test.

3. Results

Figure 1 presents the ambient temperature (AT) inside the pig house (control pens) and in the exposure paddocks. Ambient temperature ranged from 26.8 ^{o}C to 29.0 ^{o}C (mean, 27.8 ^{o}C) within the control pens (CP) and from 38.0 ^{o}C to 43.9 ^{o}C (mean, 40.5 ^{o}C) within the exposure Paddocks (PD). Thus the ambient temperature of the exposure paddocks exceeded that of the control pens by about 12.7 ^{o}C.

The effects of genotype on body temperature (BT) and haematological profile of the experimental boars are presented in Table 2. Body temperature, LC, EC, HbC, MCV and MCH differed significantly ($P < 0.01$) between genotypes while PCV and MCHC were similar in the two genotypes. Large White boars exceeded ($P < 0.01$) the crossbred boars in BT (40.83 vs 39.49 ^{o}C), LC (17.37 x 10^{9}/l) vs 15.03 x 10^{9}/l) and EC (7.71 vs 6.44 x 10^{6}/l), but were inferior ($P < 0.01$) in HbC (12.68 vs 13.19 g/dl), MCV (56.85 vs 69.69 fi) and MCH (16.89 vs 20.57 pg).

Table 3 presents the effects of duration of exposure on body temperature (BT) and haematological profile of the boars. Boars exposed to solar heat for 60 min. presented the highest value for BT (41.97 ^{o}C) compared to boars exposed for 45 min (41.22 ^{o}C) which was in turn higher than the control boars (37.28 ^{o}C). Leukocyte count, EC, HbC and PCV of boars exposed for 45 and 60 min. were similar but these exposed groups significantly ($P < 0.05$) exceeded the control in these parameters. For the erythrocyte (RBC) indices, MCV did not differ significantly ($P > 0.05$) between treatments while MCH and MCHC were significantly ($P < 0.05$) higher in the control (20.21 and 32.10 pg, respectively) compared to the exposed boars which were similar.

The interaction effects of genotype x duration of exposure on body temperature and haematological profile are presented in Table 4. Body temperature differed significantly ($P < 0.05$) across treatments for LW boars (37.78, 41.78 and 42.93 ^{o}C for control, 45 and 60 min. exposures, respectively) but only between exposed and control boars for the crossbred. Leukocyte count, EC, HbC, PCV, MCV and MCHC were similar for the exposed boars in the two genotypes but differed significantly ($P < 0.05$) between exposed and control boars. However, MCV decreased significantly ($P < 0.05$) with duration of exposure in the LW boars (61.36, 56.08 and 53.11 fi for control, 45 and 60 min. exposures, respectively), but increased significantly ($P < 0.05$) with exposure in the crossbred boars (64.76, 72.60 and 71.72 fi for control, 45 and 60 min. exposures, respectively). The same trend was observed for MCH in the LW boars but not for the crossbred boars which had similar MCH values across treatments.

Table 5 presents the comparative mean ± S.E for BT and haematological indices of LW and crossbred boars for each treatment. The table shows significant ($P < 0.05$) between genotype differences for all traits studied except for HbC and PCV for the exposed boars, MCV for the control and MCHC for all treatments. Large White boars surpassed the crossbred boars in BT and LC in all treatments and also in EC in the exposed groups (8.31 ± 0.25 x 10^{9}/l vs 6.50 ± 0.14 x 10^{9}/l for 45 min. exposure and 8.97 ± 0.42 x 10^{9}/l vs 6.83 ± 0.27 x 10^{9}/l for 60 min. exposure). On the other hand, the crossbred boars were significantly ($P < 0.05$) higher in EC, HbC and PCV among the control boars (6.00 ± 0.03 x 10^{9}/l vs 5.84 ± 0.03 x 10^{9}/l, 12.33 ± 0.05 vs 11.59 ± 0.12 g/dl and 38.86 ± 0.23 % vs 35.82 ± 0.25 %, respectively); MCV among exposed boars (72.60 ± 1.15 fi vs 56.08 ± 1.13 fi and 71.72 ± 0.83 fi vs 53.11 ± 0.69 fi for 45 min and 60 min exposures, respectively) and MCH for all treatments.

4. Discussion

The wide difference between outdoor and indoor ambient temperatures indicate that pigs reared outdoors were exposed to higher ambient temperatures and may suffer heat stress more than those reared indoors. The mean ambient temperature indoors was 27.8 ^{o}C which exceeded the recommended optimum temperature range of 21 to 24 ^{o}C for growing pigs in hot-humid environments (Mayer and Bucklin, 2009). The outdoor ambient temperature of 40.54 ^{o}C within the period of exposure means an increase of 12.7 ^{o}C above the indoor temperature and 16.5 ^{o}C above the recommended optimum production ambient temperature. This indicates considerable thermal stress for animals reared outdoors.

The significantly lower BT observed for the crossbred boars compared to LW boars (Table 2) indicate that the crossbred boar has greater capacity for heat tolerance compared to the LW. Locally adapted breeds of livestock are known to have greater adaptation to higher ambient temperatures of the tropics (Hansen, 2004). This genetic attribute may have been transferred to the crossbred boars. Genetic differences in tolerance to thermal stress within and between temperate and tropical breeds are well documented (Hansen, 2004; Renaudeau *et al.,* 2007; Soleimani and Zulkifi, 2010). The significant differences between genotypes in haematological indices reflect genetic variation in the effect of heat stress on blood parameters. For instance, the significantly higher value of LC observed in LW boars compared to the crossbred (LWxLC) boars could mean greater immunological response of LW boars to heat stress (Mellesse, 2011). Some components of blood leukocytes: neutrophils, basophils and monocytes have been shown to increase under heat stress as reported by (Leek *et al.,* 2004; Karthiayini and Philomina, 2008). The significantly higher EC observed in LW boars could result from (1) genetic differences in RBC count (2) hemoconcentration probably due to greater evaporative heat loss by the LW boars or (3) greater mobilization of RBCs from hematopoetic tissues to meet tissue demand for oxygen

which increases under heat stress. The significantly lower HbC in the LW boars could result from RBC hypertrophy which reduces HbC per unit volume of RBC or RBC proliferation since MCV and MCH were also lower in this genotype.

The highly significant differences between exposed and control (unexposed) boars for most parameters studied (Table 3) could be attributed to differences in thermal environment (indoor vs outdoor). Body temperature for boars exposed for 45 and 60 min. exceeded that of the control by 3.9 ^{o}C and 4.7 ^{o}C, respectively which indicates greater thermal pressure on the animals outdoor. The significant differences in BT between boars exposed for 45 and 60 min. show that core body temperature increased with duration of exposure to direct sunlight and that once the upper BT limit has been exceeded, additional exposure aggravated the effect of thermal stress on body temperature. The significantly elevated LC, EC, HbC, and PCV in the exposed groups indicate significant alteration in blood parameters probably in response to heat stress. The significantly reduced MCH and MCHC suggest that thermal stress leads to a reduction in average red blood cell haemoglobin content. There is paucity of information on the effect of heat stress on whole blood count and RBC indices of pigs reared in the tropics. However, reports on other species tend to support the present findings. For instance, Gollock *et al.* (2006) found lower Hb content per RBC (lower MCHC) in the Atlantic cod (*Gadus morhua*) subjected to heat stress. The authors explained that this could be due to cell swelling (RBC hypertrophy). The same study also reported increasing cardiac output with rise in body temperature which suggests the intervention of homeostatic mechanisms (e.g., mobilization of RBC from haematopoietic organs) to maintain circulatory volume. This may explain the elevated LC, EC, HbC and PCV observed in the present study.

The significant interaction effects of genotype x duration of exposure on BT (Table 4) indicate genetic differences in ability to buffer core body temperature at the various durations of exposure. The significant increases in BT of LW boars with duration of exposure indicate higher impact of solar heat on this genotype probably due to higher metabolic rate resulting from faster growth rate (Nwakpu and Omeje, 2004). Body temperature was similar in crossbred boars exposed for 45 and 60 min. probably because the time difference was too small to cause significant differences in BT in this genotype or that this genotype has greater potentials for heat tolerance. The significantly higher LC, EC, HbC and PCV in exposed compared to control boars of each genotype further suggests that these blood components are influenced by heat stress. The significant decrease in MCV, MCH and MCHC in exposed LW boars could be due to RBC proliferation in reaction to heat stress resulting in more but smaller RBCs. Furthermore, reduction in MCV, MCH and MCHC could result from significant shifts in the normal proportional relationship between EC and HbC. In mammals, EC is approximately one-third of HbC (Velguth *et al.,* 2010). In the present study, the ratio of HbC to EC for LW boars were 1.985, 1.558 and 1.496 for control, 45 and 60 min. exposures, respectively. The corresponding values for crossbred boars were 2.055, 2.055 and 2.035, respectively. Thus the HbC:EC ratio was less altered in the crossbred boars than in LW boars. Hb:EC ratio may thus be sensitive to (thermal) stress probably due to the functional relationship between haemoglobin and RBC with regard to oxygen supply to tissues which increases under heat stress. Shifts in HbC:EC ratio could hence be an index of heat stress in pigs in addition to neutrophil:lymphocyte ratio. This however calls for further scrutiny. Mean corpuscular haemoglobin was similar (unaffected) across treatments in the crossbred boars probably because only marginal increases in EC occurred with exposure in this genotype.

The significantly higher BT observed in LW boars across treatments (Table 5) confirm the lesser heat tolerance of this breed. Leukocyte count was also higher in LW boars across treatments confirming that it has greater immune response to heat stress. The significantly higher levels of EC for LW boars exposed to sunlight show that there was probably greater proliferation/mobilisation of RBC in this breed compared to the crossbred boars. Mean corpuscular volume and MCH were however, higher in crossbred boars suggesting that this genotype may have larger RBCs or that RBC proliferation in the LW boars produced comparatively smaller RBCs. Animals that display higher power of adaptation in an environment have been reported to have higher RBC and RBC nucleus area and volume than less fit ones (Emiroglu *et al.,* 2012).

4. Conclusion

Exposure to direct sun light significantly raised the rectal temperature of exposed boars above normal range which indicated thermal stress. The haematological indices of the two genotypes were also altered. Exposed LW boars were more severely affected. Extensively reared animals should have access to wallow pits and shades as a management strategy against direct solar radiation, high ambient temperature and heat stress. Again, selection and crossbreeding for heat tolerance should be undertaken to ensure improved productivity in the future.

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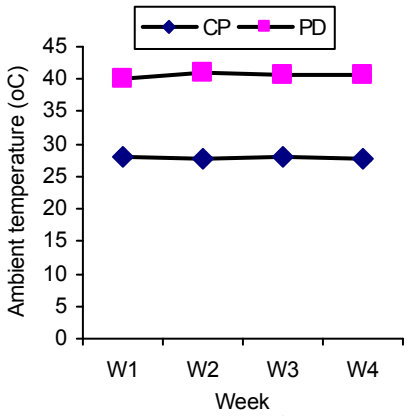

Figure 1: Comparative mean weekly ambient temperature (°C) for control (CP) and exposure paddock (PD). Over the experimental period, ambient temperature was significantly ($P < 0.05$) higher in the exposure paddocks than in the control pens.

Table 1: Meteorological data (solar radiation) for the experimental site ($MJm^{-2}day^{-1}$)

Month	Min.	Max.	Mean
2008			
June	13.9	32.7	24.6
July	8.4	38.0	21.0
August	6.4	37.2	19.4
September	2.0	37.2	21.5
October	7.7	38.9	28.1
November	17.2	41.3	31.8
December	6.2	40.2	28.8
2009			
January	8.7	41.3	27.8
February	9.5	39.2	28.7
March	7.1	41.3	29.5
April	17.2	40.0	27.1
May	4.2	41.3	27.9
June	13.6	37.8	26.1

Min.: minimum; Max.: maximum. Source: Department of Crop Science Meterological Station, UNN (2008/2009).

Table 2: Effect of genotype on body temperature and blood profile of Large White and Large White x Local crossbred boars

	Variable							
Genotype	BT (°C)	LC (x 10^9/l)	EC (x 10^9/l)	HbC (g/dl)	PCV (%)	MCV (fi)	MCH (pg)	MCHC (pg)
LW	40.83^a	17.37^a	7.71^a	12.68^b	43.57	56.85^b	16.89^b	29.64
LW x LC	39.49^b	15.03^b	6.44^b	13.19^a	45.34	69.69^a	20.57^a	29.49
S.E. M.	0.09	0.29	0.14	0.15	0.67	0.64	0.22	0.26
P value	0.00	0.00	0.00	0.02	0.06	0.00	0.00	0.69

a,b: means on the same column with different superscripts are significantly different ($p < 0.05$). LW: Large White; LW x LC: Large White x local crossbred. S. E.: standard error of mean. BT: body temperature (measured as rectal temperature); LC: leukocyte count; EC: erythrocyte count; HbC: haemoglobin concentration; PCV: packed cell volume; MCV: mean corpuscular volume; MCH: mean corpuscular haemoglobin; MCHC: mean corpuscular haemoglobin concentration.

Table 3: Effect of duration of exposure to direct sunlight on body temperature and blood profile of Large White and Large White x Local crossbred boars

	Duration of exposure				
Variable	Control	45 min.	60 min.	S. E.	P value
BT (^{o}C)	37.28^{c}	41.22^{b}	41.97^{a}	0.11	0.00
LC (x 10^{9}/l)	13.01^{b}	17.51^{a}	18.08^{a}	0.35	0.00
EC (x 10^{9}/l)	5.92^{b}	7.40^{a}	7.90^{a}	0.17	0.00
HbC (g/dl)	11.96^{b}	13.15^{a}	13.69^{a}	0.19	0.00
PCV (%)	37.34^{b}	47.42^{a}	48.61^{a}	0.81	0.00
MCV (fi)	63.06	64.34	62.41	0.79	0.21
MCH (pg)	20.21^{a}	18.25^{b}	17.71^{b}	0.26	0.00
MCHC (pg)	32.10^{a}	28.14^{b}	28.47^{b}	0.32	0.00

a,b,c: means on the same row with different superscripts are significantly different ($p \leq 0.05$); BT: body temperature (measured as rectal temperature); LC: leukocyte count; EC: erythrocyte count; HbC: haemoglobin concentration; PCV: packed cell volume; MCV: mean corpuscular volume; MCH: mean corpuscular haemoglobin; MCHC: mean corpuscular haemoglobin concentration; control: zero duration of exposure.

Table 4: Effect of interaction of genotype x duration of exposure on body temperature and blood profile of Large White (LW) and crossbred (LW x LC) boars

Variable	Genotype	Control	45 min.	60 min.	S. E. M.	P value
BT (^{o}C)	LW	37.78^{c}	41.78^{b}	42.93^{a}	0.16	0.00
	LW x LC	36.78^{b}	40.67^{a}	41.01^{a}		
LC (x 10^{9}/l)	LW	13.69^{b}	19.18^{a}	19.23^{a}	0.50	0.00
	LW x LC	12.33^{b}	15.84^{a}	16.93^{a}		
EC (x 10^{9}/l)	LW	5.84^{b}	8.31^{a}	8.97^{a}	0.23	0.00
	LW x LC	6.00^{b}	6.50^{b}	6.83^{a}		
HbC (g/dl)	LW	11.59^{b}	12.95^{a}	13.50^{a}	0.26	0.00
	LW x LC	12.33^{b}	13.36^{a}	13.88^{a}		
PCV (%)	LW	35.82^{b}	46.74^{a}	48.16^{a}	1.15	0.00
	LW x LC	38.86^{b}	48.11^{a}	49.05^{a}		
MCV (fi)	LW	61.36^{a}	56.08^{b}	53.11^{b}	1.11	0.00
	LW x LC	64.76^{b}	72.60^{a}	71,72^{a}		
MCH (pg)	LW	19.86^{a}	15.79^{b}	15.01^{b}	0.37	0.00
	LW x LC	20.57	20.72	20.41		
MCHC (pg)	LW	32.42^{a}	28.07^{b}	28.43^{b}	0.45	0.00
	LW x LC	31.77^{a}	28.20^{b}	28.51^{b}		

a, b, c: means on the same row with different superscripts are significantly different ($p < 0.05$); BT: body temperature (measured as rectal temperature); LC: leukocyte count; EC: erythrocyte count; HbC: haemoglobin concentration; PCV: packed cell volume; MCV: mean corpuscular volume; MCH: mean corpuscular haemoglobin; MCHC: mean corpuscular haemoglobin concentration; control: zero duration of exposure; S.E: standard error of mean.

Table 5: Comparison between genotypes for body temperature and blood profile for different duration of exposure

Variable	Genotype	Control	P value	45 min.	P value	60 min.	P value
BT (^{o}C)	LW	37.78 ± 0.11^{a}	0.00	41.78 ± 0.15^{a}	0.00	42.93 ± 0.16^{a}	0.00
	LW X LC	36.78 ± 0.09^{b}		40.67 ± 0.20^{b}		41.01 ± 0.22^{b}	
LC (x 10^{9}/l)	LW	13.69 ± 0.10^{a}	0.00	19.18 ± 0.69^{a}	0.00	19.23 ± 0.79^{a}	0.02
	LW X LC	12.33 ± 0.15^{b}		15.84 ±0.40^{b}		16.93 ± 0.47^{b}	
EC (x 10^{9}/l)	LW	5.84 ± 0.03^{b}	0.00	8.31 ± 0.25^{a}	0.00	8.97 ± 0.42^{a}	0.00
	LW X LC	6.00 ± 0.03^{a}		6.50 ± 0.14^{b}		6.83 ± 0.27^{b}	
HbC (g/dl)	LW	11.59 ± 0.12^{b}	0.00	12.95 ± 0.20	0.09	13.50 ± 0.44	0.52
	LW X LC	12.33 ± 0.05^{a}		13.36 ± 0.12		13.88 ± 0.38	
PCV (%)	LW	35.82 ± 0.25^{b}	0.00	46.74 ± 1.38	0.48	48.16 ± 1.61	0.67
	LW X LC	38.86 ± 0.23^{a}		48.11 ± 1.32		49.05 ± 1.25	
MCV (fi)	LW	61.36 ± 1.38	0.08	56.08 ± 1.13^{b}	0.00	53.11 ± 0.69^{b}	0.00
	LW X LC	64.76 ± 1.32		72.60 ± 1.15^{a}		71,72 ± 0.83^{a}	
MCH (pg)	LW	19.86 ± 0.22^{b}	0.01	15.79 ± 0.39^{b}	0.00	15.01 ± 0.11^{b}	0.00
	LW X LC	20.57 ± 0.15^{a}		20.72 ± 0.74^{a}		20.41 ± 0.23^{a}	
MCHC (pg)	LW	32.42 ± 0.44	0.20	28.07 ± 0.49	0.87	28.43 ± 0.51	0.90
	LW X LC	31.77 ± 0.23		28.20 ± 0.60		28.51 ± 0.30	

a, b: means on the same column with different superscripts are significantly different ($p < 0.05$); BT: body temperature (measured as rectal temperature); LC: leukocyte count; EC: erythrocyte count; HbC: haemoglobin concentration; PCV: packed cell volume; MCV: mean corpuscular volume; MCH: mean corpuscular haemoglobin; MCHC: mean corpuscular haemoglobin concentration; control: zero duration of exposure; LW: Large White; LC: local.