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Assessment of changes in physiological parameters and immune marker levels in cattle presented for slaughter at Ikpa Nsukka slaughter abattoir

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Abstract

There is dearth of information on the use of physiological parameters and immune marker levels as indices of stress in cattle presented for slaughter. The objectives of the study were to determine the changes in physiological parameters such as heart rate, pulse rate, respiratory rate, rectal temperature and to assess the changes in immune marker levels like total leucocyte count, differential leucocyte count and neutrophil/lymphocyte ratio as indices of stress in cattle presented for slaughter at Ikpa slaughter slab. The heart and pulse rates were determined using stethoscope and first and second fingertips count respectively. The rectal temperature (^{o}C) was determined using digital thermometer while the respiratory rate (breaths/minutes) was determined by counting the number of breaths per minute. Blood was collected from 40 cattle at two stages: 1) pre-slaughter and 2) during slaughter. The pre-slaughter and post-slaughter mean values of heart rates in the male cattle were 80.00 ± 7.48^{a} and 112.50 ± 2.87^{b} respectively. The pre-slaughter and post-slaughter mean values of heart rates in the female cattle were 51.33 ± 1.76^{a} and 64.00 ± 2.31^{a} respectively. The pre-slaughter and post-slaughter mean values of respiratory rates in the male cattle were 79.00 ± 6.61^{a} and 33.00 ± 2.52^{a} and 47.00 ± 1.00^{b} respectively. The pre-slaughter and post-slaughter mean values of respiratory rates in the female cattle were 30.67 ± 1.33^{a} and 41.33 ± 3.53^{b} respectively. The pre-slaughter and post-slaughter mean values of rectal temperature in the male cattle were 37.55 ± 0.09^{a} and 38.48 ± 0.13^{b} and 47.00 ± 1.00^{b} respectively. The pre-slaughter and post-slaughter mean values of rectal temperature in the female cattle were 38.63 ± 0.18^{a} and 38.60 ± 0.06^{a} respectively. A slight non-significant increase in the neutrophil/lymphocyte ratio in the different sex groups at pre-slaughter and slaughter were observed. In conclusion, changes in heart rate, pulse rate and respiratory rate are more indicative of acute stress which is associated with slaughter processes in Ikpa abattoir.

Keywords: cattle, stress, slaughter, leucocytes.

Une Évaluation des changements dans les paramètres physiologiques et les niveaux de marqueur immunitaire chez les bovins présentés pour l'abattage à l'abattoir d'Ikpa Nsukka

Résumé

Il n y a guerre d'information sur l'utilisation des paramètres physiologiques et des niveaux de marqueur immunitaire comme indices de stress chez les bovins présentés pour l'abattage. Les objectifs de l'étude étaient de déterminer les changements dans les paramètres physiologiques tels que la fréquence cardiaque, le pouls, la fréquence respiratoire, la température rectale et d'évaluer les changements dans les niveaux de marqueur immunitaire comme le nombre total de leucocytes, le nombre différentiel de leucocytes et le rapport neutrophile/lymphocyte comme indices de stress chez les bovins présentés pour l'abattage à la dalle d'abattage Ikpa. Les fréquences cardiaques ont été déterminées à l'aide du

stéthoscope et le premier et le deuxième doigts comptent respectivement. La température rectale (le 'OC') a été déterminée à l'aide d'un thermomètre numérique, tandis que la fréquence respiratoire (respirations/minutes) a été déterminée en comptant le nombre d'respirations par minute. Le sang a été prélevé sur 40 bovins à deux étapes : 1) avant l'abattage et 2) pendant l'abattage. Les valeurs moyennes des fréquences cardiaques chez les bovins mâles avant l'abattage et après l'abattage étaient respectivement de 80,00 ±7,48a et 112,50±2,87 milliards. Les valeurs moyennes des fréquences cardiaques chez les bovins femelles avant l'abattage et après l'abattage étaient respectivement de 51,33 ±1,76a et 64,00±2,31a. Les valeurs moyennes des taux respiratoires chez les bovins mâles avant l'abattage et après l'abattage étaient respectivement de 79,00±6,61a et 33,00±2,52a et 47,00±1,00b. Les valeurs moyennes des taux respiratoires chez les bovins femelles avant l'abattage et après l'abattage étaient de 30,67 ±1,33a et 41,33±3,53 milliards respectivement. Les valeurs moyennes de température rectale avant l'abattage et après l'abattage chez les bovins mâles étaient respectivement de 37,55±0,09a et 38,48±0,13b et 47,00±1,00b. Les valeurs moyennes de la température rectale avant l'abattage et après l'abattage chez les bovins femelles étaient respectivement de 38,63±0,18a et 38,60±0,06a. Une légère augmentation non significative du rapport neutrophile/lymphocyte dans les différents groupes sexuels au pré-abattage et à l'abattage a été observée. En conclusion, les changements de la fréquence cardiaque, de la fréquence cardiaque et de la fréquence respiratoire sont plus révélateurs du stress aigu associé aux processus d'abattage à l'abattoir Ikpa.

Mots-clés: bovins, stress, abattage, leucocytes.

Introduction

A variety of physiological changes in response to stressor had been reported in fish as the primary stage involved neuroendocrine response such as catecholamine's release and activation of corticotrophin inter-renal axis, followed by secondary response such as haematological, metabolic, blood enzymatic and osmoregulatory changes. Pre-slaughter stress, such as fighting, cold weather, fasting and transit, which occurs some hours prior to slaughter depletes muscle glycogen, resulting in meat which has a higher pH, darker color, and is drier. Psychological stressors, such as excitement and fighting, will often have a more detrimental effect on meat quality than physical stressors. Stress is defined as the biological response elicited when an animal perceives a threat to its homeostasis (Moberg, 2000). Stress can also be defined as adverse effect in the environment or management system which forces changes in the animal's physiology or behavior to avoid physiological malfunctioning and assist the animal in coping with its environment (Ferguson and Warner, 2008). Stress leads to fight or flight response, so an animal can experience faster pumping lungs, increase heart rate, higher blood pressures and endorphins flooding the body. Also appetite, libido and immune system is shut down in order that energy is diverted to muscle to prepare for flight (Ranabir and Reetu, 2011). Animals can be stressed by either psychological factors (hunger, thirst, separation from group, mixing with unfamiliar group or novelty), physical factors (such as restraint, handling, fatigue or injury) and environmental factors (temperature and noise) (Etim and William, 2013). The main stressors in an animal's life are danger, illness, pain, accident, synthetic chemicals, inappropriate diet, weaning, confinement, isolation, overcrowding, change in routine, change in environment

and over-stimulation (Etim and William, 2013).

Biological response to a stressor is used as an indicator of stress (Kumar *et al.*, 2012). Vocalisation, restlessness, fight, pain, refusal to move, increase in heart, blood pressure variability and increase in respiratory rate as behavioural indicator for stress (Broom, 2003). Endocrine indicators used in determining acute stress level include corticotrophin-releasing hormone, catecholamine (epinephrine and norepinephrine), cortisol, adrenocorticotropic hormone, oxytocin, vasopressin, prolactin, glucagon, serotonin, opiates and gonadotrophins (Sapolsky, 2000). Immune indicators that can be used in determining stress include increase in neutrophil/lymphocyte ratio and blood monocyte count (Sapolsky, 2000). Biochemical markers used in determining the level of acute stress in animals include urea level, glucose level, packed cell volume (PCV), total protein albumin, creatinine kinase level (CK), aspartate transaminase (AST), lactate level, alkaline phosphatase (ALP) and blood potassium level (Calamari *et al*., 2003; Lay and Wilson, 2004; Abeni *et al*., 2007). There is dearth of information on the use of physiological parameters and immune marker levels as indices of stress in cattle presented for slaughter. The objectives of the study were to evaluate the changes in physiological parameters (heart rate, pulse rate, respiratory rate and rectal temperature) and in immune marker levels (total leucocyte count, differential leucocyte count and neutrophil/lymphocyte ratio) of cattle presented for slaughter at Ikpa slaughter slab.

Materials and methods

The rectal temperature was measured using a clinical thermometer (Naylor *et al*., 2010); The heart rate was measured using a stethoscope (David and Dumitrascu, 2017); The pulse rate of the animals was determined by placing the thumb on superficial arteries and the pulsating effect of the vessel was counted as beat in a minute (Tibballs and Russell, 2009). The respiratory rate of each animal was determined by calculating the number of movements of the flank in a minute (Legates *et al*., 1991). Blood sample was collected from the jugular vein using sample bottle containing ethylene diamine tetraacetic acid (EDTA) from the animals 48 hrs before slaughter and during slaughter at the abattoir. Total white blood cell count was obtained using the haemocytometer counting method and while thin blood smear made on clean grease-free glass slides for differential leukocyte count were stained following the Leishman technique and enumerated by the meander counting method (Thrall and Weiser, 2002).

Results

Changes in values of heart rate, pulse rate, respiratory rate and rectal temperature at pre-slaughter and at slaughter in the different sex groups of Bovine were reported in the Table 1. Changes in value of total leucocytes; differential white blood cell counts (neutrophils, lymphocytes, monocytes, eosinophils and neutrophil/lymphocyte ratio) in the male and female groups of Bovine at 48 hr pre-slaughter and at slaughter were shown in Table 2.

Table 1: Changes in bovine vital parameters (pre and at slaughter)

Parameter	Group	48 hr pre-slaughter	Slaughter
Heart rate (bpm)	Male	80.00±7.48[a]	112.50±2.87[b]
	Female	51.33±1.76[a]	64.00±2.31[a]
Pulse rate (bpm)	Male	79.00±6.61[a]	113.50±9.00[b]
	Female	49.33±2.67[a]	74.67±7.42[b]
Respiratory rate (cpm)	Male	33.00±2.52[a]	47.00±1.00[b]
	Female	30.67±1.33[a]	41.33±3.53[b]
Rectal temp (°C)	Male	37.55±0.09[a]	38.48±0.13[b]
	Female	38.63±0.18[a]	38.60±0.06[a]

[ab]Mean with superscript in rows indicate a significant difference at $p<0.05$.

Table 2: Mean changes in total and differential WBC at pre-slaughter and at slaughter in cattle

PARAMETER	Group	48 hr pre-slaughter	Slaughter
Total leucocyte ($*10^3/\mu l$)	Male	8.10±0.85[a]	8.24±0.47[a]
	Female	6.93±0.75[a]	8.63±0.85[a]
Neutrophils ($*10^3/\mu l$)	Male	3.67±0.56[a]	4.05±0.31[a]
	Female	3.24±0.30[a]	4.16±0.35[a]
Lymphocytes ($*10^3/\mu l$)	Male	3.73±0.20[a]	3.80±0.11[a]
	Female	3.51±0.63[a]	4.14±0.59[a]
Monocytes ($*10^3/\mu l$)	Male	0.55±0.11[a]	0.33±0.13[a]
	Female	0.18±0.10[a]	0.28±0.05[a]
Eosinophils ($x10^3/\mu l$)	Male	0.17±0.07[a]	0.07±0.04[a]
	Female	0.00±0.00[a]	0.05±0.05[a]
Neutrophil / Lymphocyte ratio	Male	0.97±0.10[a]	1.07±0.08[a]
	Female	0.97±0.16[a]	1.02±1.31[a]

[ab]Mean with superscript in rows indicate a significant difference at $p<0.05$.

Discussion

The significant increase in the heart rate, pulse rate, respiratory rate and rectal temperature) in the both sex groups of the cattle at pre-slaughter and slaughter could be as a result of fear perceived by the animals during handling and restraint at slaughter. These changes also were observed by Apple *et al*. (2005) in a work done on the effect of handling and restraint on cattle. Catecholamine and cortisol are released during stressful conditions and they will lead to an increase in levels of physiological parameters in other to maintain homeostasis (Sontag *et al*., 2010). The significant variation in the heart and pulse rates and rectal temperature between the male and female cattle could be as a result of sex differences in stress response. Bale and Epperson (2015) reported that sex differences in stress response can be found at all stages of life and these differences is related to the organizational and activational effects of gonadal hormones (testosterone and estrogen) and also to the various genes found on the sex chromosomes. In this study, the male group responded more to stressors associated with slaughter than the female group. This was also observed in the work done on pigs by Morta-Rojas *et al*. (2006) that male animals are more susceptible to changes in vital signs associated with stress than the female because the male animals are more excited and aggressive. The increase in neutrophil/lymphocyte ratio in the different

sex groups at pre-slaughter and slaughter in this study could be as a result of increase in level of neutrophil and decrease in level of lymphocyte. Elevated levels of glucocorticoids have been reported to lead to an increase in the level of neutrophils and a decrease in level of lymphocytes resulting in variations in total leukocyte level (Davis *et al*., 2008).

Conclusion

It can be concluded from this study that changes in vital parameters (heart rate, pulse rate and respiratory rate) are more indicative of acute stress which is associated with slaughter processes in Ikpa abattoir. Animals should be given enough rest while they are kept in lairage before slaughter to avoid stress in these animals. Also proper handling of animals should be adopted by Butchers during slaughter to avoid stressing them which could affect the quality of meat.

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