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Using Eye and Nasal Temperatures to Measure Positive Emotions in Free-Range Hamdani Sheep

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Abstract: The present study was designed to measure both eye and nasal temperatures by stroking the animals' body to determine positive emotional state in free-range Hamdani ewes. Twenty Hamdani ewes, aging 2-4 years, were used in this study. Focal sampling was used to collect data. Data were collected from both nose and eyes of animals. A total of 1680 temperature data, an average of 84 data from each ewe, were collected from all twenty ewes throughout the study. Ewes were stroked at the forehead, withers and neck for five minutes, temperature data were collected twice before, twice during and twice after stroking for both eyes and nose. Results revealed that there was a significant difference in eye temperature ($P<0.01$) as well as nasal temperature ($P<0.05$) between the three stages. Both eye and nasal temperatures were decreasing over time. In addition, the mean eye and nasal temperatures for all stopwatches were highly correlated ($r = 0.94$). From this study it could be concluded that peripheral (eye and nose) temperatures offer a useful understanding of changes in emotional valence in ewes.

Keywords: Eye and nasal temperature; positive emotions; sheep; stroking.

Introduction

It is well-known that animals are sentient, which means they can feel and are emotional creatures and they have right to have good welfare. Therefore, assessing the welfare of animals needs a good comprehending of the animals' affective experience include emotions of animals (Boissy & Lee, 2014). Self-report, on the written or oral communication, is the best evaluation for assessing stress or affective state in humans (Herr *et al*., 2006). Because this approach does not exist in animals, there should be some other indicators (Guatteo *et al*., 2012). These indicators most often are concerned with behavior and physiology (Watts, 2014). Depending on physiological indicators, measuring surface temperature is frequently used in animals, although using peripheral areas like nasal and eye temperatures of animals as indicators for emotional states in non-human animals are not completely understood (Boissy & Lee, 2014). Some studies have been undertaken in cows (Proctor & Carder, 2015a). Yet, little is known about sheep (Beausoleil *et al*., 2004).

A rise in the temperature of the core body for a short period is caused by both psychological and physical stresses in several mammals such as cattle (Macaulay *et al*., 1995; Proctor & Carder, 2015a) and sheep (Beausoleil *et al*., 2004). The short-lived increase in the core body temperature is called emotional fever (Beausoleil *et al*., 2004; Proctor & Carder, 2015a) and is a convenient indicator of animal welfare (Beausoleil *et al*., 2004). The measurement of the core body temperature requires animal handling, which affects the emotional state of animals (Stewart *et al*., 2008b). Alternatively, scientists used non-invasive measures to indicate emotional states of animals (Proctor & Carder, 2015a; 2016). Vasoconstriction of the nose and eyes is related to emotional fever. During fight or flight state, the diversion of blood from peripheral areas such as the eyes and nose occurs towards internal body organs (Proctor & Carder, 2015a). The stress axis (hypothalamic pituitary axis) are activated as well, which increases the concentrations of glucocorticoid and catecholamine, which causes more heat loss (Jansen *et al*., 1995). The heat loss is detected by a drop in peripheral temperature, for instance, nasal (Proctor & Carder, 2016) and eye temperatures (Stewart *et al*., 2008a). In sheep and cattle, eye temperature was used for detecting negative states (Beausoleil *et al*., 2004; Stewart *et al*., 2008a). Nasal temperature was used to determine positive emotional state in cows (Proctor & Carder, 2016); however, no study was undertaken to measure nasal and eye temperatures to detect positive emotional state in sheep, particularly free-range sheep. In this study, stroking the animals' body was used to measure positive emotions of sheep. The stroking of animal body is often used during daily interactions between stockperson and animals (Schmied *et al*., 2008). Stroking was also used in several studies in farm animals such as pigs, sheep, cattle, goats and chicken (Boivin *et al*., 2003). Stroking was used to measure behavior and heart rates (Schmied *et al*., 2008). It was shown that gentle stroking improved handling (Boivin *et al*., 1992), decrease fear from humans (Rushen *et al*., 1999), reduced distress (Tallet *et al*., 2005), improved the quality of meat (Lensink *et al*., 2001) and decreased the percentage of visible eye white (Proctor & Carder, 2015b). Thus far, no study was undertaken to stroke the animals gently to measure positive emotional state in free-range sheep. Therefore, the purpose of the present research was to measure both eye and nasal temperatures by stroking the animals' body to determine positive emotional state in free-range Hamdani ewes.

Materials and Methods:

Study Site and Subjects

This study was undertaken in Hawrez Village, locating in the North of Zakho, Duhok-Kurdistan Region of Iraq. The study was carried out in October and November 2017. Twenty non-pregnant non-lactating sound Hamdani ewes, aging 2 – 4 years, were used in this study. Animals were placed at their housing throughout the study. Animals had a free access to water and they moved outside for grazing as they were not provided with any feed indoor.

Collecting Temperature Data

Focal sampling was used to collect data. Data were collected from both nose and eyes of animals. A total of 1680 temperature data, an average of 84 data from each ewe, were collected from all twenty ewes throughout the study. Temperature data were collected using an infrared thermometer gun (Benetech, Inc, USA) with a red laser point during temperature measurement. The environmental emissivity and temperature may affect the values of temperature that was taken by infrared thermometer gun. Therefore, they were adjusted in the thermometer and the surface emissivity was estimated as 0.95 according to Girardin *et al*. (1999) as shown just above the temperature on the thermometer gun. The emissivity was set at 0.95, which was the ewe's ability to emit and absorb infrared radiation (Alsaaod & Büscher 2012).

During the process, the temperature was measured from a distance of 0.5 to 1 meter as it was precisely done by Proctor & Carder (2015a). All data were collected of the ewes head on the right side with 0 – 15^{o} angle, and eye and nasal temperatures, described as the best place by Stewart *et al*. (2007) and Proctor & Carder (2015a), were recorded by an infrared thermometer gun with the place that its temperature was determined normally the eyeball with around 1 cm surrounding the eye and the outer part of the nose. Ewes were stroked on the forehead, withers and neck for five minutes. Temperature data, from each ewe, were collected five minutes before stroking at the minutes 00:30 (minutes: seconds) and 04:30, and five minutes during stroking at the stopwatch points 05:00 and 09:59, then five minutes after stroking at the stopwatch points 10:30 and 14:30. Recording nasal and eye temperatures from these points of time allowed the researcher to make a comparison between pre-stroking, stroking and post-stroking stages.

Data Analysis

All temperature data were placed in Microsoft Excel spreadsheet to be analyzed. Data were analyzed using GenStat Software Program (17th edition, VSN International Ltd, UK). According to Shapiro-Wilk normality test data were parametric, therefore they were analyzed using the One-Way Analysis of Variance (ANOVA) repeated measures test to analyze the difference in mean eye and nasal temperatures measured from each ewe at the three stages: before, during and after stroking. For post hoc comparisons, Fisher's Unprotected LSD test was used. Summary statistics were also obtained from GenStat Software. Using a Pearson correlation in Excel, the correlation between nasal and eye temperature was obtained. The figures were prepared by Microsoft Excel as well.

Results

The mean eye temperature for all three stages of stroking is shown in Fig. (1). There was a significant difference between the three stages (P<0.01). The mean eye temperature was 33.3 ± 0.3, 31.8 ± 0.3 and 30.8 ± 0.3 °C of before, during and after stroking respectively.

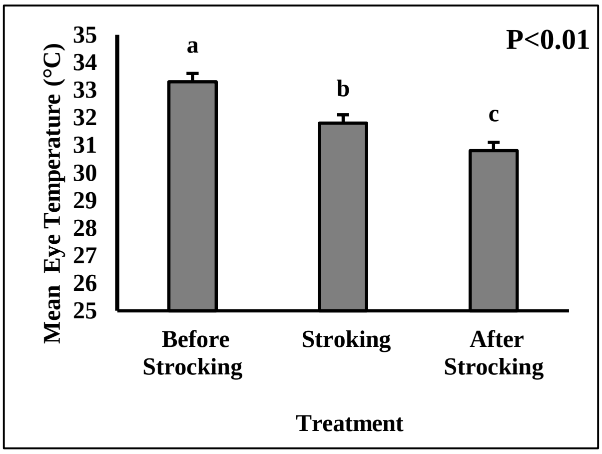

Fig. (1): Mean ± SE eye temperature of Hamdani ewes for the stages of before, during and after stroking.

There was also a significant difference (P<0.05) between the stages before and after stroking the ewes in the mean of nasal temperature (Fig. 2). No significant difference was found when ewes were stroked compared to pre-stroking and post-stroking. The mean nasal temperature was 28.5 ± 0.5, 27.6 ± 0.4

and 26.9 ± 0.3 °C of before, during and after stroking respectively.

The mean eye and nasal temperatures for all stopwatch times of pre-stroking, stroking and after stroking is shown in Fig. (2). Both trends of eye and nasal temperature were similar during different stages. The mean eye temperature was 33.2 ± 0.4, 33.5 ± 0.3, 32.1 ± 0.5, 31.5 ± 0.4, 30.7 ± 0.3 and 31.0 ± 0.5 °C for stopwatches (minute: second) 00:30, 04:30, 05:00, 09:59, 10:30 and 14:30, respectively. The mean nasal temperature was 28.6 ± 0.7, 28.4 ± 0.8, 27.4 ± 0.4, 27.7 ± 0.6, 26.7 ± 0.3 and 27.1 ± 0.6 °C respectively for the abovementioned stopwatches (Fig. 3).

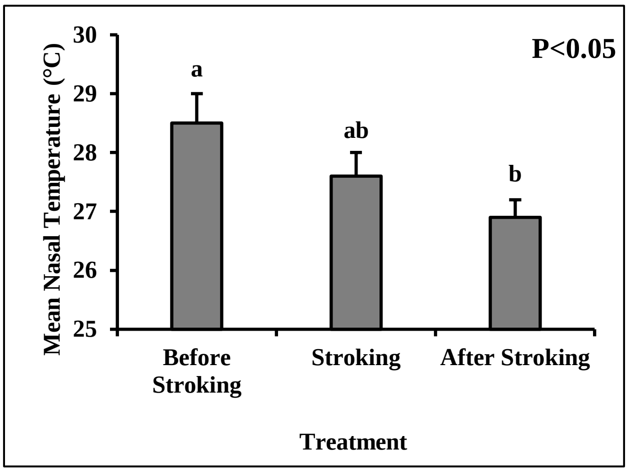

Fig. (2): Mean ± SE nasal temperature of Hamdani ewes for the stages of before, during and after stroking.

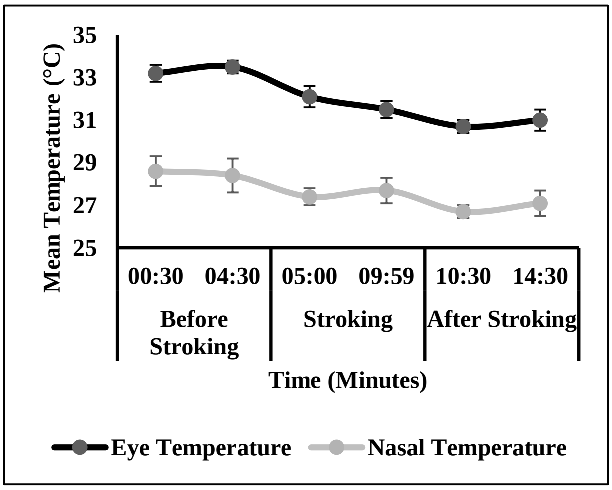

Fig.(3): Mean ± SE eye and nasal temperature for all stopwatches of pre-stroking, stroking and post-stroking stages.

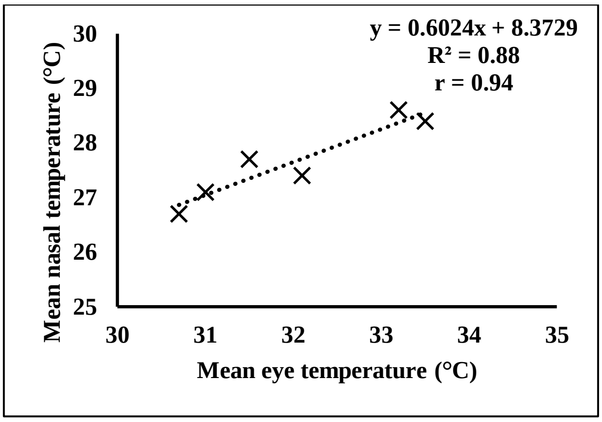

Fig. (4): The correlation between the mean eye and nasal temperature for all stopwatch times of the three stages of stroking.

The correlation coefficient between eye temperature and nasal temperature for all stopwatch times was obtained (Fig. 4). The mean eye temperature for all stopwatches was highly correlated with the mean nasal temperature (r = 0.94).

Discussion

The main purpose of this study was to measure positive emotional state of free-range ewes by stroking ewes using the eye and nasal temperatures. Stroking had a significant effect on a free-range ewe's emotions indicated by drop in both eye and nasal temperature. In addition, both eye and nasal temperatures were highly correlated. Few studies presented the use of eye and nasal temperatures as an indicator of ewe's emotional state. Studies up to the present time unpleasant and stressful stimuli dropped eye and nasal temperatures. Most of them has concentrated only on the negative emotional states. For instance, a study by Ludwig *et al*. (2010) showed that there was a significant decrease in both eye and ear temperatures in rabbits in response to negative stimuli. Similarly, there was a significant drop in eye temperature of cows as a result of different stressful handling procedures (Stewart *et al*., 2005).

Few studies to date focused on the positive emotions of animals. The temperature of laying hen's comb decreased with the introduction of favored meal due to vasoconstriction of peripheral areas, which caused a drop in comb temperature of hens (Moe *et al*., 2012). However, the comb temperature was also decreased as a result of simple handling (Cabanac & Aizawa, 2000). It is suggested from previous studies that both negative and positive emotions drop peripheral temperature in animals (Proctor & Carder, 2015a). This drop in peripheral temperature causes emotional fever, an increase in the core body temperature. Therefore, not only the negative emotions cause emotional fever, but also the positive emotions do. It was argued that an emotional fever could be less reflective of valence than arousal, although both positive and negative stimuli resulted in drop of peripheral temperature (Moe *et al*., 2012). It was therefore argued by Proctor & Carder (2015a) that little is known to attribute emotional fever, rise in core body temperature to arousal state, in which the effect of low arousal stimuli is unclear.

As far as known it is the first study undertaken to measure positive emotions in a free-range ewes. A study by Proctor & Carder (2016) measured nasal temperature for both negative and positive emotions of cows by offering inedible feed (negative) and favored concentration (positive), both stimuli were significantly decreased nasal temperature. Similarly, Proctor & Carder (2015a) measured the nasal temperature of cows to study the effect of positive emotional state by stroking cows' body, as a result, they found there was a significant drop in nasal temperature of cows, and therefore it was suggested that the drop in nasal temperature can indicate changes in the emotional valence.

The findings of this study are similar to the results of Proctor & Carder (2016). In this study, the peripheral temperatures during stroking were 1.5 (eye temperature) and 0.9 °C (nasal temperature) lower than pre-stroking. Similarly, stroking in another studies caused a decrease in heart rate and cortisol level of cows (Waiblinger *et al*., 2004; Schmied *et al*., 2010). Therefore, the change in emotional valence decreased the peripheral temperatures not the arousal level (Proctor & Carder, 2015a). It is probably that emotional valence caused a drop in both eye and nasal temperatures by stroking similar to that drop in nasal temperature caused by stroking and offering favored feeding in cows (Proctor & Carder, 2015a; 2016). However, Proctor & Carder (2015a) found an increase in nasal temperature after stroking, in this study the contrary was found, in which mean nasal as well as eye temperatures were lower in pre-stroking than stroking stage. It was stated that the increase in nasal temperature might be the result of changing the emotional valence to negative or neutral states. In this study, it was unclear that this decrease after stroking was continuing in positive emotions or not, however at the last stopwatch, there was an increase in both eye and nasal temperatures by 0.3 and 0.4 °C, respectively as both peripheral areas mean temperatures were highly correlated (Fig. 4). Decreasing peripheral temperatures might be a cause of negative emotions post-stroking, as a disappointment of the end of stroking that caused positive emotions. Similar results were found when cows offered a favored concentrated food. (Proctor & Carder, 2015a).

Conclusions

From this study, it could be concluded that peripheral (eye and nasal) temperatures offer a useful understanding of changes in emotional valence in ewes. As most of research depended on measuring negative emotional states, further research is required to measure emotional valence of sheep, particularly positive emotions to make changes in peripheral temperatures on emotional valence obvious. More studies are needed to measure positive emotions using nasal and eye temperatures with different positive stimuli.

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