Perspective

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Journal of Animal Research and Nutrition

2023
Vol.8 No.2:073

The Study of Muscle Activity Using Surface Electromyography in Animal

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Received date: February 11, 2023, Manuscript No. IPJARN-23-16271; **Editor assigned date:** February 13, 2023, PreQC No. IPJARN-23-16271 (PQ); **Reviewed date:** February 24, 2023, QC No. IPJARN-23-16271; **Revised date:** March 04, 2023, Manuscript No. IPJARN-23-16271 (R); **Published date:** March 11, 2023, DOI: 10.36648/2572-5459.8.2.073

Citation: Ruiz B (2023) The Study of Muscle Activity Using Surface Electromyography in Animal. J Anim Res Nutr Vol. 8 No2: 073

Description

The study of muscle activity using surface electromyography is commonly used for investigations of the neuromuscular system in man. Although has faced methodological challenges, considerable technical advances have been made in the last few decades. Similarly, the field of animal biomechanics, including, has grown despite being confronted with often complex experimental conditions. In human research, standardised protocols have been developed, however these are lacking in animal. Before standards can be proposed in this population group, the existing research in animal should be collated and evaluated. Therefore the aim of this review is to systematically identify and summarise the literature in animal focussing on (1) species, breeds, activities and muscles investigated, and (2) electrode placement and normalisation methods used. The databases were searched systematically for sEMG studies in animals and 38 articles were included in the final review. Data on methodological quality was collected and summarised. The findings from this systematic review indicate the divergence in animal sEMG methodology and as a result, future steps required to develop standardisation in animal sEMG are proposed.

In humans, the study of muscle activity using Surface Electromyography (sEMG) is widely used for investigations of the neuromuscular system. Not only is it applied in healthy populations to assess the role and interactions of muscles during functional tasks and sport and exercise, it is also used in clinical groups to understand muscle adaptations and dysfunctions in musculoskeletal injury, pain and pathology. sEMG has made considerable technical advances in the last few decades, however, divergence in sEMG methodology between many research groups led to limitations in direct comparisons between studies. In order to standardise sEMG, the project surface electromyography for the non-invasive assessment of muscles was established which provides guidelines for sensor placement and signal processing. Furthermore, the International Society of Electromyography and Kinesiology (ISEK) have produced standards for sEMG reporting.

Although an interest in animal biomechanics has existed for centuries, the use of sEMG in animal populations is considerably less often reported compared to the human literature. The nature of capturing sEMG data in animals poses many challenges for researchers in this field. These are not limited to, but include, how to prepare densely hairy, woolly or greasy skin for optimal electrode adhesion whilst achieving minimal electrode-skin impedance, and where to place the electrodes. Added to this are behavioural constraints, how can I encourage the animal to perform a movement accurately and consistently? As a result, certain techniques commonly used in human sEMG data collection such as obtaining an isometric Maximal Voluntary Contraction (MVC) for the purpose of sEMG data normalisation, are impossible in animals. Despite these challenges, the number of studies on sEMG in animals is steadily growing, with the majority of work having been carried out in equines. The advent of wireless sEMG in particular has been a positive step in opening the doors to research questions which would otherwise have been very difficult to obtain using a wired system in animal populations.

Although the body of knowledge in animal muscle function through the use of sEMG is growing, this area of research is plagued by the same lack of standardisation in sEMG methodology which human sEMG studies faced prior to the development of recommendations. Before standards in animal sEMG can be proposed however, an overview of past and present research practices in animal sEMG needs to be gained. To our knowledge, no attempts have been made to summarise the scientific literature in animal sEMG. An overview which compares the methodologies utilised in animal sEMG studies would allow aspects such as agreement or disparity in electrode placement and approaches to signal processing to be identified. It might also suggest how one major challenge, the normalisation of sEMG in animals, can be best managed.

Instead, we encourage an approach from a different direction. Can music ameliorate a specific welfare problem based on what we know about how music produces effects on animals? We believe that the almost exclusive focus on the question of “What effect does music have on animals?” without complementary investigations into questions such as “How does music produce effects on animals?” is insufficient to advance the scientific or practical understanding of the utility of music as an enrichment tool. We focus on first exposing some methodological issues of experimental design and data interpretation and argue that these issues impede a clear grasp of whether and how music is affecting animal wellbeing. Next, we review leading hypotheses about the mechanisms through which music affects animals and suggest that considering animals’ perceptual abilities will yield invaluable insights into understanding the how music works and how we can use it to improve welfare. Finally, we introduce a

conceptual framework for Auditory Enrichment Research, which underlines that music is not necessarily special and should be treated as any other auditory stimulus, and argue that the specific welfare goals, animals' perceptual abilities, and musical features must all be considered when studying how music or other sounds can be used to improve animal welfare.

Livestock systems have each positive and negative effect on the natural resources base, public health, social equity and economic process. Currently, farm animal is one in all the quickest growing agricultural subsectors in developing countries. Its share of agricultural gross domestic product is already thirty three per cent and is quickly increasing. This growth is driven by the apace increasing demand for farm animal product, this demand being driven by growth, urbanization and increasing incomes in developing countries.

By the time of early civilizations like ancient Egypt, cattle, sheep, goats and pigs were being raised on farms. Fossilized chicken bones dated to 5040 BC are found in northeastern China, aloof from wherever their wild ancestors lived within the jungles of tropical Asia, however archaeologists believe that the first purpose of domestication was for the game of blood sport.