Unravelling the toxic and pro-inflammatory potential of inhalable mineral dusts generated from racehorse working surfaces

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The second leading causes of reduced performance in racehorses, after musculoskeletal injuries, is represented by respiratory problems. Most of these are inflammatory in origin, meaning that the horse respiratory system reacts to external stimuli that can be considered dangerous to for the equine respiratory system. This stimuli are many and can be represented by infectious agents, such as bacteria and or viruses, by inhaled organic compounds (such as pollens, mold and fungal wall particles) or by inorganic irritants (such as ammonia, for example). When these compounds are present in high quantity within the air, air quality is reduced and the risk of lung disease may increase.

Among air contaminants with high toxic potential for the airways, there is silica dust, also known as RCS (respirable crystalline silica). Silica is highly abundant on Earth as it composes many sands and rocks, and we all are exposed to silica daily. However, silica becomes particularly aggressive for our respiratory system when its particles are so small they can reach the most distant part of the lung (the alveoli) and when it is freshly fractured. Most equine surfaces are composed of silica in variable parts (40-90% reported in North America). The friction imposed by equine hoofs on such surfaces, especially at high speeds, can generate surface dusts of such a small size they can reach the lungs and produce an inflammatory response. Data on this regard are currently lacking in horses, however.

With the current proposal, we would like to study the composition and toxic and inflammatory potential of a representative sample of 15 currently employed surfaces in racing and training facilities for racehorses in our region, and to relate these data with their RCS content.

To do so, we will characterize the particle size distribution and mineralogical composition of the collected surfaces, we will treat them to inactivate non-mineral components and we will use chemical and biological tools to determine the outcomes of interest. A special machine will determine the free radical (oxidant) generation capacity of the surface studied and their dusts. Other tests conducted in laboratory will assess the interaction of the surfaces and their dusts on equine red blood cell membrane. If the red blood cells rupture, it indicates a high toxic potential of the compound tested. Finally, cells harvested immediately postmortem from equine lungs will be cultured in the presence or absence of different concentrations of the surfaces and their dusts, and their production of pro-inflammatory mediators will be monitored in time. Altogether, these data, after appropriate statistical analysis, will provide answers to our research questions and will determine whether more research efforts will have to be granted on this subject. In particular, the next step would be a large-scale clinical study to determine whether a link exists between the prevalence of equine respiratory diseases in racehorses and surface-generated dust exposure and to establish guidelines (on surface choice and/or management practices) for safe breathing in equine racing environments.