

Summary

In recent years, the progress of veterinary science has contributed to the longevity of animals. However, along this development, the number of metabolic and age-related disorders in animals has been rapidly increasing. Similarly to humans, many major diseases are related to metabolic conditions, therefore investigating the metabolic biomarkers is beneficial for both animals and humans. In this study, we investigated and compared the metabolic systems in large animals, such as bottlenose dolphins (*Tursiops truncatus*), horses, and cows. Comparative studies are helpful because this knowledge can offer critical information, leading to establishing the basic standard data and discovering the distinct features of the animals. It is also advantageous to use this knowledge for other fields, including the human medical field.

1. Cholesterol Lipoprotein Profiles of Large Animals

Cholesterol profile patterns between bottlenose dolphins (*Tursiops truncatus*, hereinafter referred to as dolphins), horses, and cows showed that all animal groups were classified into HDL dominant mammals, such as dogs and cats. Dolphins and horses also displayed clear LDL-Chol peak, which was not shown in cows, thus the cholesterol profile of dolphins is a closer resemblance to that of horses, rather than that of cows. Evidence now indicates that understanding the characteristics in the lipid and lipoprotein parameters of each animal group is necessary for maintaining a healthy metabolism in animals. In addition, various factors can often alter the patterns, so investigating how they are involved in lipid metabolism can lead to a more specific evaluation of an animal's metabolic state. Overall, monitoring the plasma lipid concentrations and cholesterol profile in animals is useful to detect abnormal metabolic states in order to prevent various metabolic-related disorders.

2. Comparison of Energy Metabolism and LDH Isoenzyme Patterns in Large Animals

Regarding energy metabolism between these animal groups, dolphins appear to have the greatest level of oxidative energy metabolism amongst horses and cows, due

to having the greatest levels of plasma MDH activity. In addition, dolphin energy production/usage efficiency was second (M/L ratio = 0.67) behind that of horses (M/L ratio = 0.79). Overall, these results suggest that dolphins may possibly generate more energy than horses, especially for increased mobility in the water; however, all of the produced energy is not utilized for various reasons, such as a smaller tank size or other environmental limitations. However, cows demonstrated the highest plasma LDH activity amongst all animal species. This may have been attributed to their lactating state. Although all animal groups displayed a different plasma LDH isoenzyme pattern distribution, dolphins and horses demonstrated a similarity with LDH-3 isoenzyme predominating in plasma, as opposed to LDH-1 in cows, which would reflect “Symmorphosis” of these two species and their aerobic/anaerobic energy metabolism needs.

Overall, plasma MDH and LDH activity levels, M/L ratio, and plasma LDH isoenzyme pattern can all be useful indicators for a better understanding of the oxidative energy metabolism and monitoring of a captive animals' health. As it is not easy to obtain tissue samples from animals, the development of blood indicators for evaluating the whole body metabolic state is necessary, and further research is required and should be pursued.

3. The Aging Effect on the Metabolic System in Riding Horses

The study about the aging effect demonstrated that aging might not induce remarkable changes in a metabolic system for horses, possibly due to their continuous daily exercises. As all the horses had constant physical activity on a daily basis, recovery of the ADN level was possibly a confirmation that aged horses could improve their metabolic and immune systems, preventing a negative aging effect. Additionally, they sustained a balanced M/L ratio among all the age groups. Moreover, as elevated SOD activities in middle-aged and aged horses were displayed, their exercise protocol was a beneficial strategy to enhance anti-obesity and anti-aging promoters. In fact, due to their continuous daily exercises, the riding horses maintained their physical condition as they grew older.

Aging is an inevitable event for all living organisms. The destruction of the metabolic or immune systems accompanied with aging can completely change our lives. Although further research is required for the development of blood indicators, blood analysis can serve as a useful index for early detection and protection from metabolic-related and/or age-related diseases. Finding a key to enhance the metabolic system in order to reduce the risks for various age-related diseases can offer new intriguing avenues for a desirable and healthy life.

4. Future Directions: The Aging Effect in Dolphins

This comparative study suggested that each animal species has a distinct metabolism pattern, but there are some similarities with other species as well. From these similarities, it is possible to presume certain effects on the metabolic system in similar animal groups. Investigating and comparing the metabolism in animals can lead to a better understanding of their normal health condition. Since some animal species are often limited to research, it is important to gain helpful insights from the similarities and the differences with other species.

Evidence now indicates that daily physical activity may help improve the metabolic ability and can attenuate the negative aging effects in active animals, such as riding horses. Although dolphins appear to have a unique metabolic system, it is speculated that their regular physical activity, including shows in the daytime, have a similar impact on their health management when they age. Moreover, dolphins and humans share several features, hence examining the unique metabolic system in dolphins can lead to new, impactful, and beneficial health and disease theories for humans as well.

As stated above, comparative studies can allow us to recognize the remarkable features of the animals. The basic information gained from comparative studies can bring us profitable knowledge for establishing the standards of animal basal metabolism. A better understanding of metabolism patterns can lead to more efficient management and disease prevention strategies for these animals.

An abundance of information is hidden in the biology of animals, which we can

carefully and ethically exploit for medicine and technology areas. Given that having a balanced metabolic system is necessary for good health, identification of the advantageous metabolic process can bridge a knowledge gap in metabolic-related issues in animals and humans. Generally, the impact of exercise proved to work positively for anti-obesity and anti-aging in animals and humans. In fact, each animal species has a different energy utilization process, thus it is favorable to apply the most appropriate exercise strategy for each animal species. To improve the health management of animals, it is necessary to understand each metabolic system in order to prevent any dysregulation of metabolism, if it occurs. A comparative study can be the first step to more efficient management and disease prevention strategies. It can also offer new pragmatic avenues and therapeutic approaches for animals and humans.